Unit 01

INTRODUCTION TO BIOLOGY

Q1. What is Science?

Ans. Science is the study in which observations are made, experiments are done and logical conclusions are drawn in order to understand the principles of nature.

Q2. Why the scientific knowledge was classified into different branches?

Ans. In ancient times, all the scientific informations were included under one head i.e. 'Science'. With the passage of time scientific informations increased many folds and this enormous scientific knowledge was then classified into different branches like, biology, physics, chemistry, mathematics etc.

Q3. What Dr. Abdul Salam told about scientific knowledge?

Ans. According to Dr. Abdul Salam, scientific knowledge is the common heritage of mankind.

Q4. What is biology? Describe major divisions of biology.

Ans. Biology

The scientific study of life is called biology.

Explanation of word "Biology"

The word "biology" has been derived from two Greek words:-

(a) "Bios" meaning 'life'.

(b) "Logos" meaning 'thought or reasoning'.

What we study in biology?

The study of biology helps us in studying the structures, functions and related aspects of living organisms. It also provides information and remedies to human problems regarding health, food, environment etc.

Major Divisions of Biology

Biology can be divided into three major divisions:-

(i) Zoology

This division of biology deals with the study of animals.

(ii) Botany

This division of biology deals with the study of plants.

(iii) Microbiology

This division of biology deals with the study of microorganisms. e.g. viruses, bacteria, etc.

Q5. Define different branches of biology.

Ans. In order to study all the aspects of life, major divisions of biology are further divided into different branches as defined below:

(i) Morphology

This branch deals with the study of form and structure of living organisms.

(ii) Anatomy:

The study of internal structures is called anatomy.

(iii) Histology

The microscopic study of tissues is called histology.

(iv) Cell biology

The study of structures and functions of cells and cell organelles is called cell biology. This branch also deals with the study of cell division.

(v) Physiology

This branch deals with the study of the functions of different parts of living organisms.

(vi) Embryology

It is the study of the development of an embryo to a new individual.

(vii) Taxonomy

It is the study of the naming and classification of organisms into groups and subgroups.

(viii) Genetics

The study of genes and their role in inheritance is called genetics.

Inheritance means the transmission of characters from one generation to the other.

(ix) Palaeontology

It is the study of fossils, which are the remains of extinct organisms.

(x) Environmental Biology

It deals with the study of the interactions between the organisms and their environment.

(xi) Biotechnology

It deals with the practical application of living organisms to make substances for the welfare of mankind.

(xii) Socio-Biology

This branch deals with the study of social behaviour of animals that make societies.

(xiii) Parasitology

This branch deals with the study of parasites.

(xiv) Immunology

It is the study of immune system of animals, which defends the body against invading microbes.

(xv) Entomology

It is the study of insects.

(xvi) Pharmacology

It is the study of drugs and their effects on the systems of human body.

(xvii) Molecular Biology

It deals with the study of molecules of life; e.g. water, proteins, carbohydrates, lipids and nucleic acids. **OR** It deals with the structure of organisms, the cells and their organelles at molecular level.

Q6. What are Parasites?

Ans. Parasites are the organisms that take food and shelter from living hosts and in return, harm them. e.g., viruses, bacteria and parasitic worms.

Q7. What are the major biological issues today?

Ans. Human population growth, infectious diseases, addictive drugs and the pollution are the major biological issues today.

Q8. Describe the relationship of biology to other sciences.

Ans. Introduction

The interrelationship among different branches of science cannot be denied. Biological informations relate to the other branches of science as well. For example, when studying the process of movement in animals, the biologists have to refer to the laws of motion in Physics. This forms the basis of interdisciplinary sciences.

Figure 1.1: Relationship of biology with other sciences

(1) Bio-physics

It deals with the study of the principles of physics, which are applicable to the biological phenomena.

Example Similarity between the working principles of lever in Physics and limbs of animals in Biology.

(ii) Bio-chemistry

It deals with the study of the Chemistry of different chemical compounds and processes occurring in living organisms.

Example The study of basic metabolism of photosynthesis and respiration involves the knowledge of Chemistry.

(iii) Bio-mathematics / Biometry.

It deals with the study of using mathematical techniques and tools in biological work.

Example

To analyze the data gathered after experimental work, biologists have to apply the rules of mathematics.

(iv) Bio-geography

It deals with the study of occurrence and distribution of different species of living organisms in different geographical regions of the world.

Application of Biogeography

It applies the knowledge of the characteristics of particular geographical regions to determine the characteristics of living organisms found there.

(v) Bio-Economics

It deals with the study of organisms from economical point of view.

Example

The cost value and profit value of wheat can be calculated through this branch and benefits or losses can be determined.

Q9. Briefly describe the careers in biology.

Ans. The following are the careers that a student of biology can plan to adopt.

(i) Medicine / Surgery

(a) Medicine deals with diagnosis and treatment of diseases in human.

(b) In Surgery, the parts of body may be repaired, replaced or removed. For example, the removal of stones through renal surgery, transplantation of kidney, liver etc.

(c) Both these professions are studied in the same basic course (MBBS) after higher secondary education and the students go for specializations.

(ii) Fisheries

(a) It deals with the study of fish production and enhancing the quality and quantity of fish production.

(b) Professionals of fisheries are employed in fisheries departments of Pakistan.

(c) This profession can be adopted after the bachelor or masters level study of zoology and fisheries.

(iii) Agriculture

(a) It deals with the study of food crops and animals which are the source of food.

(b) An agriculturist works for the betterment of crops like wheat, rice, corn etc and animals.

(c) This professional course can be adopted after the higher secondary education in biology.

(iv) Animal Husbandry

(a) It is the branch of agriculture concerned with the care and breeding of domestic animals (livestock) e.g. cattle, sheep etc.

(b) This professional course can be adopted after the higher secondary education in biology.

(v) Horticulture

(a) It deals with the study of art of gardening.

(b) A horticulturist works for the betterment of existing varieties and for the production of new varieties of ornamental plants and fruit plants.

(c) This professional course can be adopted after the higher secondary education in biology.

(vi) Farming

(a) It deals with the development and maintenance of different types of farm.
For example, in some farms, animal breeding technologies are used for the production of animals which are better protein and milk source.

(b) In poultry farms, chicken and eggs are produced.

(c) In fruit farms, different fruit yielding plants are grown.
This profession can be adopted after the course of agriculture, animal husbandary or fisheries.

(vii) Forestry

(a) It deals with the study of natural forests and advises to the government for planting and growing artificial forests.

(b) This professional course can be adopted after the higher secondary education in biology or after bachelor level study of zoology and botany.

(viii) Biotechnology

(a) It deals with the study and work for the production of useful products through microorganisms.

(b) This professional course can be adopted after the higher secondary education in biology or after bachelor level studies of zoology or botany.

Q10. Explain the Islamic concept about origin of life. **(Lahore board 2011 G I) (short question)**

Ans. Allah hints about the origin and characteristics of living organisms at many places in the Holy Quran. Human beings have been instructed to expose the unknown aspects of life after getting the hints from the verses.

Verse No. 1

Creation of life from water

وَجَعَلْنَا مِنَ الْمَآءِ كُلَّ شَيْءٍ حَيٍّ ۝

"We made everything from water." (Sura: Ambia, Verse: 30)

The above verse hints at the common origin of all living things in water and water makes 60-70% of the composition of protoplasm of all living things.

Verse No. 2

Creation of Life from Clay & Method of Development

خَلَقَ الْإِنْسَانَ مِنْ صَلْصَالٍ كَالْفَخَّارِ ۝

"He made man from clay like the potter." (Sura: Rehman, Verse: 14)

Verse No.3

In another verse, God says:

ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً
فَخَلَقْنَا الْمُضْغَةَ عِظَامًا فَكَسَوْنَا الْعِظَامَ لَحْمًا ۝

"Then fashioned we the drop a clot, then fashioned we the clot a little lump, then fashioned we the little lump bones, then clotted the bones with flesh." (Sura: Al-Mominoon, Verse: 14)

In both above verses, we find the events that occurred in the creation of human beings and Allah also hints at the method of the development of animals including human beings.

Verse No. 4

Concepts of Classification

وَاللَّهُ خَلَقَ كُلَّ دَآبَّةٍ مِّنْ مَّآءٍ ۚ فَمِنْهُمْ مَّنْ يَّمْشِيْ عَلٰى بَطْنِهٖ ۚ وَمِنْهُمْ مَّنْ يَّمْشِيْ عَلٰى رِجْلَيْنِ ۚ
وَمِنْهُمْ مَّنْ يَّمْشِيْ عَلٰى أَرْبَعٍ ۚ يَخْلُقُ اللَّهُ مَا يَشَآءُ ۚ إِنَّ اللَّهَ عَلٰى كُلِّ شَيْءٍ قَدِيْرٌ ۝

"Allah hath created every animal from water, then some of them creep up over their bellies, others walk on two legs and others on four. Allah creates what He pleases."

(Sura: Al-Nur, Verse: 45)

This verse describes the common origin and modification of organisms and also supports the modern concepts of classification.

Q11. Describe the contributions of different Muslim scientists in the field of Biology.

(Jabir Bin Hayan)

Ans. Muslim scientists have made great contributions to the science and we are aware of their success in different fields of science.

(i) Jabir Bin Hayan (721-815 AD) **(Lahore board 2012 G I)**

(a) He was born in Iran and practiced medicine in Iraq.

(b) He introduced experimental investigations in chemistry and also wrote a number of books on plants and animals.

(c) His famous books are "Al-Nabatat" and "Al-Haywan".

(ii) Abdul Malik Asmai (740-828 AD) **(Lahore board 2012 G II)**

❖ He is considered the first Muslim scientist who studied animals in detail.

❖ His famous writings include "Al-Abil (camel)" , "Al-Khail (horse)", "Al-Wahoosh (animal)" and "Khalqal-ansan"

(d) Bu Ali Sina (980-1037 AD) **(Lahore board 2011 G II)**

❖ He is honoured as the founder of medicine and called as Avicenna in the west.

❖ He was a physician, philosopher, astronomer and poet.

❖ One of his best books "Al-Qanun fial-Tib" is known as the canon of medicine in west.

Photograph of Bu Ali Sina commemorated on a ticket in Poland

Q12. Describe separate and comparative description of all the levels of biological organization.

Ans. Biological organization at different levels

(1) Subatomic and Atomic level

(a) Atoms and Elements

❖ All types of matter are made up of elements.

❖ There are about 92 kinds of elements found in nature.

❖ Each element is made up of a single kind of atoms ('a': not, 'tom': cut).

❖ These atoms are actually the structures formed by many subatomic particles.

❖ The most stable subatomic particles are electrons, protons and neutrons.

(b) Bioelements

❖ Out of the 92 elements, 16 elements take part in making the body mass of a living organism called bioelements.

❖ Only six (O, C, H, N, Ca & P) make 99% of total mass. These are known as major elements.

❖ Other ten (K, S, Cl, Na, Mg, Fe,Cu, Mn, Zn & I) collectively make 1% of the total mass. These are called trace elements.

(i) Oxygen = 65% (ii) Carbon = 18% (iii) Hydrogen = 10%

(iv) Nitrogen = 3% (v) Calcium = 2% (vi) Phosphorous = 1%

(vii) Others = 1%

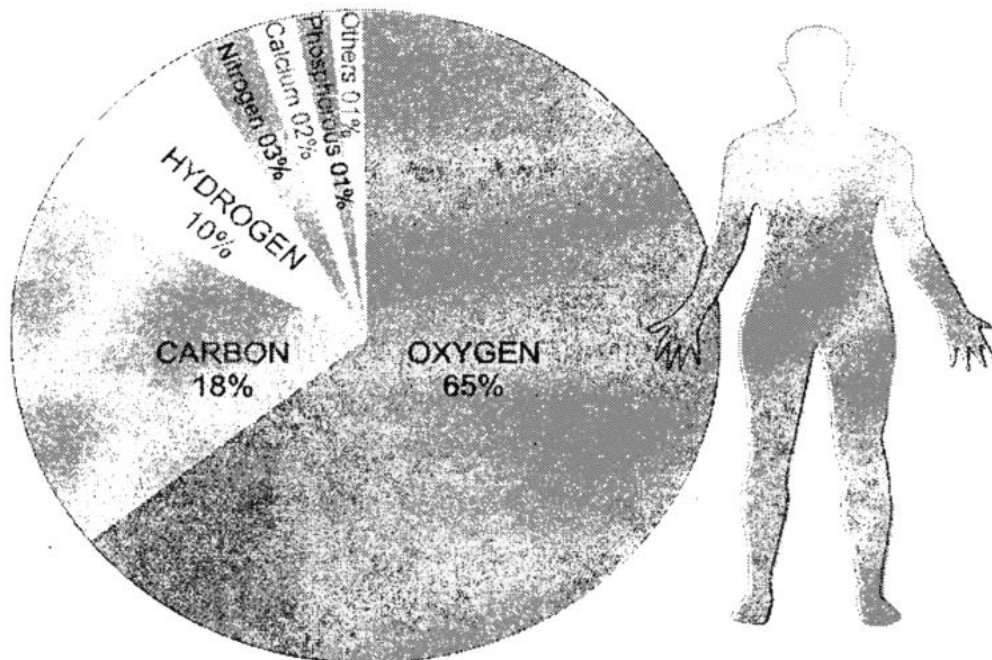



Figure 1.2: Percentage composition (by mass) of bioelements in the protoplasm of living organisms

(2) Molecular Level

(a) Biomolecules

- In organisms, bioelements usually do not occur in isolated forms rather they combine through ionic or covalent bonding.
- The stable particle formed by such bonding is called as molecule, if occurring in the bodies of living organisms they are called biomolecules.
- An organism is formed by enormous number of biomolecules of hundreds of different types.
- These molecules are the building material and are themselves constructed in great variety and complexity due to specific bonding arrangements.

Classification of Biomolecules

- Biomolecules may be classified as:

a) Micromolecules

These are molecules with low molecular weight e.g. glucose, water etc.

b) Macromolecules

These are molecules with high molecular weight e.g. starch, proteins, lipids etc.

(3) Organelle and Cell Level (Lahore board 2011 G I) (short question)

(a) Organelle Formation

- Biomolecules assemble in a particular way and form organelles.

(b) Cell Formation

- The organelles are actually sub-cellular structures and when they assemble together, cells are formed.

(c) Division of Labour within the Cell

❖ Each type of organelle is specialized to perform a specific function e.g. mitochondria are specialized for cellular respiration and ribosomes are specialized for protein synthesis. In this way, functions of the cell are accomplished by these specialized structures. It is an example of the division of labour within the cell.

No. of Cells

❖ In the case of Prokaryotes and most protists, the entire organism consists of a single cell.

❖ In the case of most fungi, all animals and plants, the organism consists of upto trillions of cells.

(4) Tissue Level

(a) Definition

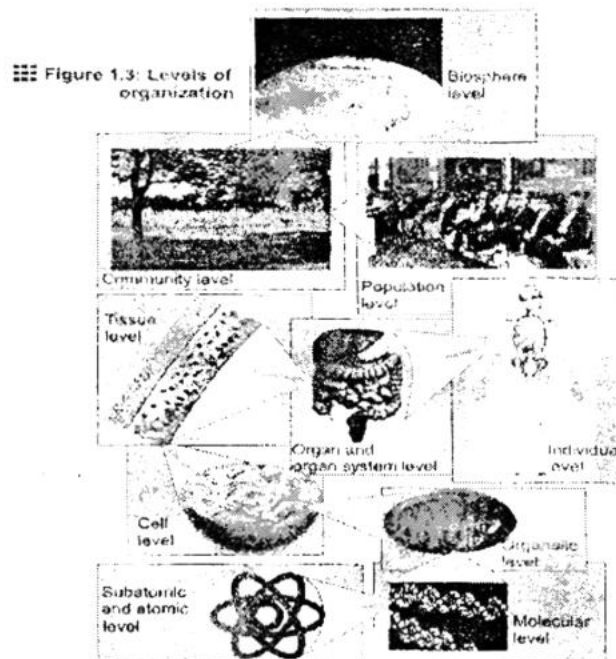
❖ A group of similar cells specialized for the performance of a common function.

(b) Explanation

❖ Each cell in a tissue carries on its own life processes (e.g. cellular respiration, protein synthesis) and also some special processes related to the function of the tissue.

(c) Examples

❖ There are different types of plant tissues, e.g. epidermal tissue, ground tissue etc. Animal tissues are also of different types e.g. nervous tissues, muscular tissues etc.

Figure 1.3: Levels of organization

(5) Organ and Organ System Level

Organ Level

(a) Formation of Organ Level

❖ More than one type of tissue having related functions are organized together to form organ.

- Different tissue of an organ perform their specific functions and these functions collectively become the functions of that organ.

(b) Example

- For example, stomach is an organ specialized for the digestion of proteins & storing food.
- Stomach have:-

(i) Epithelial (glandular) tissues which secrete the gastric juice.

(ii) Muscular tissues perform contractions of stomach walls for grinding of food, mixing enzyme with food and moving food to posterior end. So two tissues perform their functions which collectively become the function of stomach.

(iii) Connective tissue which help to connect other tissues together

(iv) Nervous Tissue: The action of stomach is co-ordinated by this tissue.

Organ System Level

(a) Formation of Organ System Level

- Different organs performing related functions are organized together in the form of an organ system.
- In organ system, each organ carries out its specific function and the functions of all organs appear as the function of the organ system.

(b) Example

Digestive system carries out process of digestion. It consists of oral cavity, stomach, small intestine, large intestine, liver and pancreas.

- The organ system level is less definite in plants as compared to animals.

(6) Individual Level

(a) Formation of Individual Level

- Different organs and organ systems are organized together to form an individual (organism).
- In an organism, various organs and organ systems are organized in such a way that all the functions, processes and activities are coordinated.

(b) Example

- During continuous and hard exercise, rate of respiration and heart beat are increased and supplies more oxygen and food to muscles which is needed for continuous work.

(7) Population Level

(a) Formation of Population Level

- A group of organisms of same species located at the same place, in the same time is called population.

(b) Example

Human population in Pakistan in 2010 comprises of 173.5 million individuals.

(8) Community Level

(a) Introduction

A community is an assemblage of different populations interacting with one another within the same environment.

(b) Example

- ❖ A forest may be considered as a community. It includes different plants, microorganisms, fungi and animal species.
- ❖ Communities are collections of organisms, in which one population may increases and others may decrease.
- ❖ Some communities are complex e.g. forest and pond community.
- ❖ Some communities are simple e.g. a fallen log with various populations under it.
- ❖ Simple communities have limited number and size and any change in biotic or abiotic factors may have drastic and long lasting effects.

(9) Biosphere Level

The part of the earth inhabited by organisms' communities is known as biosphere. It constitutes all ecosystems (area where living organisms interact with non-living components of the environment) and is also zone of life on earth.

Q13. Give comparison in cellular, colonial and multicellular organization.

Ans. Five Major Groups of Organisms

All organisms have been divided into five major groups i.e. prokaryotes, protists, fungi, plants and animals.

Types of Cells

All organisms are made of cell.

There are two basic types of cells.

Prokaryotic Cells:

Cells lacking membrane bounded nucleus and organelles are called prokaryotic cells e.g. bacteria & cyanobacteria.

Eukaryotic Cells:

Calls having membrane bounded nucleus and organelles are called eukaryotic cells e.g. animal cells, plant cells etc.

Cell Organization:

In the living organisms, the cells organize in three ways to make bodies of organisms. Cells make unicellular, colonial and multicellular organizations and the organisms formed through these organizations are unicellular organisms, colonial organisms and multicellular organisms respectively.

a) Unicellular organization: **(Lahore board 2012 G II)**

- ❖ In unicellular organisms, only one cell makes the life of an organism.
- ❖ All the life activities are carried out by the only cell.

❖ Examples: Amoeba, Paramecium, Euglena etc.

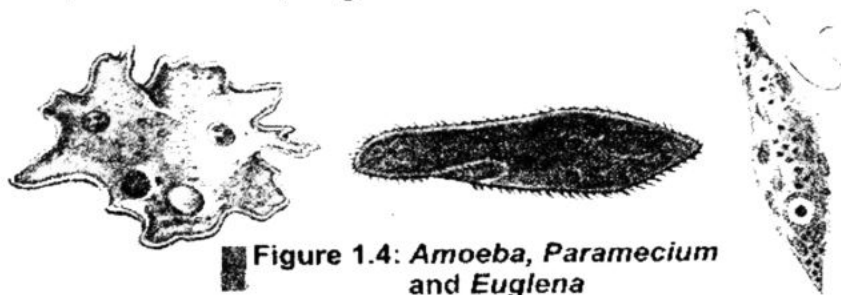



Figure 1.4: *Amoeba, Paramecium* and *Euglena*

b) Colonial Organization:

❖ In colonial type of cellular organization, many unicellular organisms live together but do not have any division of labour among them.

❖ Each unicellular organism in a colony lives its own life and does not depend on other cells for its vital requirements.

❖ Volvox is a green alga found in water is an example of colonial organization.

❖ Hundreds of volvox cells make a colony.

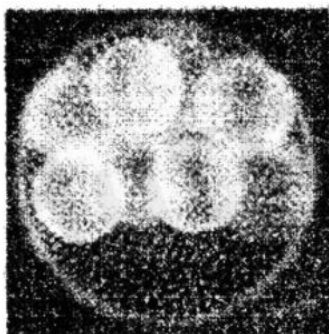



Figure 1.5 volvox colony

c) Multicellular Organization:

In multicellular organization, cells are organized in tissues, organs and organ systems.

Examples

Mustard Plant: Brassica Campestris:

(a) Sowing

❖ It is sown in winter and produces seed at the end of winter.

(b) Importance

❖ Its plant body is used as vegetable & its seeds are used for extracting oil.

(c) Body Parts

❖ Plant body consists of two parts:-

a) Vegetative Parts:

❖ It includes roots, stems, branches and leaves.

❖ These do not take part in sexual reproduction.

b) Reproductive Parts:

❖ Flowers are reproductive parts of plant because they take part in sexual reproduction and produce fruits and seeds.

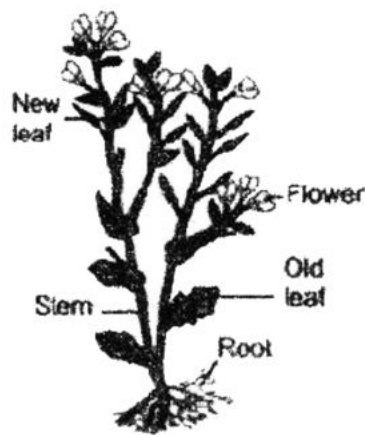



Figure 1.6: Mustard

Frog: Rana tigrina:

(a) Body

- The body of frog also shows multicellular organization.
- The body is made up of organ systems.
- Each organ system consists of related organs
- All the organs are made of specific tissues (epithelial, glandular, muscular, nervous etc.)

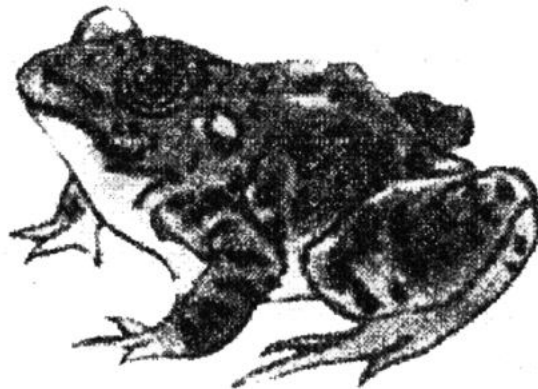



Figure 1.7 Frog

Q.14: What do you know about species?

Ans. A species is defined as a group of organisms capable of interbreeding and producing fertile offspring.

Q.15: What is habitat?

Ans. Habitat means the area of the environment in which organism lives.

Multiple Choice Questions

1. Members of the same species living in the same place at the same time make a;
   (a) Habitat (b) Biosphere
   (c) Community (d) Population
2. If a scientist is studying the methods of inserting human insuline gene in bacteria, which branch of biology may this be?
   (a) Anatomy (b) Physiology
   (c) Biotechnology (d) Pharmocology
3. Which one will be the correct sequence of the levels of organization of life?
   (a) Cell, organelle, molecule, organ, tissue, organ system, individual
   (b) Molecule, tissue, organelle, cell, organ system, organ, individual
   (c) Molecule, organelle, cell, tissue, organ, organ system, individual
   (d) Organ system, organ, tissue, cell, molecule, organelle, individual
4. Which of these major bioelements is the highest percentage in protoplasm?
   (a) Carbon (b) Hydrogen
   (c) Oxygen (d) Nitrogen
5. Which of the following group include organisms all of which are absorptive in their nutrition?
   (a) Protists (b) Animals
   (c) Bacteria (d) Fungi
6. Similar cells organized into groups and performing same functions, are known as:
   (a) Organelle (b) Tissue
   (c) Organ (d) Organ System
7. Which of these tissues also makes the glandular tissue in animals?
   (a)Epithelial tissue (b)Muscular tissue
   (c)Connective tissue (d)Nervous tissue
8. The level of organization that is less definite in plants is:
   (a) Tissue level (b) Organ level
   (c) Organ system level
   (d) Individual level
9. What is true about volvox?
   (a) Unicellular prokaryote
   (b) Unicellular eukaryote
   (c) Colonial eukaryote
   (d) Multicellular eukaryote
10. When we study the feeding relations among different animal species of a forest, at what level of organization we are studying?
    (a) Individual (b) Population
    (c) Community (d) Biosphere
11. ________ knowledge is the common heritage of mankind.
    (a) Scientific (b) Islamic
    (c) Biological (d) None of these
12. The example of colonial organism is:-
    (a) Amoeba (b) Volvox
    (c) Frog (d) Mustard plant
13. The example of micromolecule:-
    (a) Starch (b) Protein
    (c) Fats (d) Water
14. Microscopic study of tissues is called:-
    (a) Physiology (b) Morphology
    (c) Histology (d) Anatomy

15. Which one is major biological issues today?
(a) Infectious diseases
(b) Addictive drugs
(c) Environmental pollution
(d) All of these

16. Organisms of a species living in a particular habitat at a particular time:
(a) Population (b) Community
(c) Individual (d) None of these

17. Study of insects is called:
(a) Immunology (b) Entomology
(c) Genetics (d) Ecology

18. Water makes __________ of the composition of protoplasm of all living things.
(a) 60% (b) 70%
(c) 50-60% (d) 60-70%

19. The number of bioelements is:
(a) 92 (b) 6 (c) 16 (d) 10

20. How much nitrogen is present in making body mass of a living organism?
(a) 10% (b) 3%
(c) 1% (d) 18%

21. Which of the following are supporting tissues in animals?
(a) Nervous (b) Epithelial
(c) Muscular (d) Connective

22. The author of "Al-Qanun-fial-Tib" is:
(a) Jabir Bin Hayan
(b) Abdul Malik Asmai
(c) Bu Ali Sina (d) None

23. Which of the following is not unicellular organism?
(a) Amoeba (b) Paramecium
(c) Frog (d) Euglena

24. Which one are not vegetative organs?
(a) Roots (b) Stems
(c) Leaves (d) Flowers

25. Scientific name of frog is:
(a) Rana tigrina
(b) Rosa indica
(c) Rana Tagrina
(d) Brassica Campestris

26. Forest community is an example of __________ community.
(a) Simple (b) Complex
(c) Coordinated (d) None

27. The study of internal structure is called:
(a) Anatomy (b) Histology
(c) Entomology (d) Taxonomy

28. As a bioelement, the percentage of carbon is:
(a) 18% (b) 10%
(c) 2% (d) 3%

29. Biology is a word of which language?
(a) Latin (b) Arabic
(c) Greek (d) English

30. The reproductive part of plant is:
(a) Stem (b) Leaves
(c) Root (d) Flower

31. Stomach is an example of:
(a) Tissue level
(b) Organ level
(c) Organ system level
(d) None

Answers													
1.	d	6.	B	11.	a	16.	a	21.	d	26.	b	31.	b
2.	c	7.	A	12.	b	17.	b	22.	c	27.	a		
3.	c	8.	C	13.	d	18.	d	23.	c	28.	a		
4.	c	9.	C	14.	c	19.	c	24.	d	29.	c		
5.	d	10	c	15.	d	20.	b	25.	a	30.	d		

Short Questions

Q.1. What do you know about agriculture?

Ans. It deals with the study of food crops and animals which are the source of food. An agriculturist works for the betterment of crops like wheat, rice, corn etc and animals. This professional course can be adopted after the higher secondary education in biology.

Q.2. Define anatomy.

Ans. The branch of biology which deals with the study of internal structure of the organisms is called internal morphology or anatomy.

Q.3. What is animal husbandary?

Ans. It deals with the study of care and breeding of livestock.

Livestock includes all the domestic animals like cattle, sheep etc.

This professional course can be adopted after the higher secondary education in biology.

Q.4. Define molecular biology or biochemistry. **(Lahore board 2012 G II)**

Ans. The branch of biology which deals with the study of the molecules of life. e.g. water, proteins, carbohydrates, lipids and nucleic acids is called molecular biology. The study of biochemical reactions occurring in living organisms is also included in this branch.

Q.5. What do you know about bioeconomics?

Ans. The study of organisms from economical point of view. It includes the study of cost effectiveness and viability of biological projects e.g. the cost value and profit value of wheat can be calculated through this branch and benefits or losses can be determined.

Q.6. What are bioelements?

Ans. The elements which take part in making the body mass of a living organism are called bioelements. These are 16 in number. There are two types of bioelements.

(i) Major elements: Six elements making 99% mass of living organisms are called major elements. These are C, H, O, Ca, N and P.

(ii) Trace elements: Other ten elements making 1% mass of living organisms are called trace elements. These are K, S, Cl, Na, Mg, Fe, Cu, Mn, Zn & I.

Q.7. Define biogeography.

Ans. The study of occurrence and distribution of different species of animals and plants in different geographical regions of the world is called biogeography.

Q.8. Define biology.

Ans. The scientific study of living things is called biology. The word "biology" is derived from two Greek words:

(a) "Bios" meaning 'life'. (b) "Logos" meaning 'thought or reasoning'.

Biology has three major divisions:

i. **Botany**: The scientific study of plants is called botany
ii. **Zoology**: The scientific study of animals is called zoology
iii. **Microbiology**:The scientific study of microorganisms is called microbiology.

Q.9. What do you know about biomathematics?

Ans. The study of practical and theoretical applications of mathematical techniques and tools in biological processes and research is called biomathematics e.g. To analyze the data gathered after experimental work.

Q.10. What do you mean by biomolecules?

Ans. Atoms of different bioelements combine through ionic or covalent bonding to form stable particles called biomolecules or molecules of life.

An organism is formed by enormous number of biomolecules of hundreds of different types e.g. glucose, amino acids, fatty acids, starch, proteins, lipids etc.

Q.11. Define biophysics. **(Lahore board 2012 G II)**

Ans. It deals with the study of the principles of physics, which are applicable to the biological phenomena. e.g. similarity between the working principles of lever in Physics and limbs of animals in Biology.

Q.12. What is biotechnology?

Ans. The branch of biology which deals with the practical application of the knowledge about microorganisms to carry out processes, which make substances for the welfare of mankind.

Q.13. Define botany.

Ans. The branch of biology which deals with the study of plants is called botany. e.g. mustard, rose.

Q.14. What is cell?

Ans. Cell is the basic unit of structure and function of living organisms. Different organelles assemble together to form the simplest living unit i.e. the cell. It may be prokaryotic cell i.e without distinct nucleus and eukaryotic cell i.e. with distinct nucleus.

Q.15. Define Cell biology.

Ans. The branch of biology which deals with the study of structures and functions of cells and cell organelles is called cell biology. This branch also deals with the process of cell division.

Q.16. What do you mean by colony? Give example.

Ans. When many unicellular organisms live together and each of them lives its own life and does not depend on other cells for its vital requirements, it is called a colony. e.g. Volvox is a green colonial alga living in water.

Q.17. What is community? Give example. **(Lahore board 2011 G II)**

Ans. Different populations interacting with one another and living in the same environment form community.

For example, forest. It includes different plant species (oak trees, ash trees, grasses, bushes) different species of microorganisms, fungi and animals.

Q.18. Define embryology.

Ans. The branch of biology which deals with the study of the development of a new individual from fertilized egg to a new born baby is called embryology. It includes cell growth, differentiation, and morphogenesis (the process that gives rise to tissues and organs).

Q.19. What is entomology?

Ans. The branch of biology which deals with the study of insects. It includes the general characteristics and life cycles of beneficial and harmful insects.

Q.20. What do you mean by environmental biology?

Ans. The branch of biology which deals with the study of the interactions between organisms and their environment is called environmental biology.

Q.21. What do you know about farming?

Ans. It deals with the study of different types of farm, their development and maintenance. For example, in some farms animal breeding technologies are used for the production of animals which are better protein and milk source.

- In poultry farms, chicken and eggs are produced.
- In fruit farms, different fruit yielding plants are grown.

Q.22. What is fisheries?

Ans. It deals with the study of fish production and enhancing the quality and quantity of fish production.

Professionals of fisheries are employed in fisheries departments of Pakistan.

This profession can be adopted after the bachelor or masters level study of zoology and fisheries.

Q.23. What is forestry?

Ans. It deals with the study of natural forests and advises to the government for planting and growing artificial forests. This professional course can be adopted after the higher secondary education in biology or after bachelor level study of zoology and botany.

Q.24. What are fossils?

Ans. Fossils are dead remains of extinct organisms and their impressions preserved in rocks. Study of these fossils is called palaeontology.

Q.25. Define Genetics.

Ans. The branch of biology which deals with the study of the structure and functions of genes and biological inheritance of characters from one generation to the other is called genetics.

Q.26. What do you mean by histology?

Ans. The branch of biology which deals with the microscopic study of tissues is called histology.

Q.27. What do you know about horticulture?

Ans. It deals with the study of art of gardening.

A horticulturist works for the betterment of existing varieties and for the production of new varieties of ornamental plants and fruit plants.

This professional course can be adopted after the higher secondary education in biology.

Q.28. Define Immunology.

Ans. The branch of biology which deals with the study of immune system of animals which defends the body against invading microbes.

Q.29. What is inheritance?

Ans. Inheritance means transmission of characters from one generation to the other.

Q.30. Define macromolecules. Give examples.

Ans. The molecules with high molecular weights are called macromolecules e.g. starch, proteins, lipids etc.

Q.31. Define microbiology.

Ans. The branch of biology which deals with the study of microorganisms is called microbiology e.g. viruses, bacteria, etc.

Q.32. Define micromolecules. Give examples.

Ans. The molecules with low molecular weights are called micromolecules e.g. glucose, amino acids, fatty acids etc.

Q.33. What are microorganisms?

Ans. The organisms which cannot be seen with naked eye. We use microscope in order to see them are called microorganisms e.g. viruses, bacteria, protozoans etc.

Q.34. What is morphology?

Ans. The branch of biology which deals with the structure of living organisms is called morphology. It is of two types. If we study the external structure of the organisms, it is called external morphology. When we study internal structure of the organisms, it is called internal morphology or anatomy.

Q.35. Define organ. Give examples.

Ans. In higher multicellular organisms, particularly in animals, more than one type of tissue having related functions are organized together to form a unit, called organ. For example, stomach is an organ specialized for the digestion of proteins and storing food.

Q.36. What is organ system? Give examples.

Ans. In higher multicellular organisms, particularly in animals, different organs performing related functions are organized together in the form of an organ system. For example, digestive system carries out process of digestion. It consists of oral cavity, stomach, small intestine, large intestine, liver and pancreas.

Q.37. What do you mean by organelles? Give examples.

Ans. An enormous number of biomolecules become associated in a particular way and form organelles. The organelles are actually sub-cellular structures. e.g. mitochondria, ribosomes etc.

Q.38. Define Palaeontology. **(Lahore board 2011 G I)** **(Lahore board 2011 G II)**

Ans. The branch of biology which deals with the study of fossils, which are the remains of extinct organisms.

Q.39. What are Parasites?

Ans. Parasites are the organisms that take food and shelter from living hosts and in return, harm them.

Q.40. Define Parasitology. **(Lahore board 2011 G I)**

Ans. The branch of biology which deals with the study of parasites is called parasitology. The structure, habitats, mode of transmission, life histories and host – parasite relationships are studied in this branch.

Q.41. What do you know about Pharmacology?

Ans. The branch of biology which deals with the study of drugs and their effects on the systems of human body.

Q.42. Define Physiology.

Ans. The branch of biology which deals with the study of the functions of different parts of living organisms is called physiology.

Q.43. Define Population. Give examples.

Ans. A group of organisms of same species located in the same place, at the same time is called population. For example human population in Pakistan in 2010 comprises of 173.5 million individuals.

Q.44. What are Prokaryotes and eukaryotes. Give examples. **(Lahore board 2011 G II)**

Ans. The organisms which do not have well defined nucleus and membrane bounded organelles in their cells are called prokaryotes. e.g. bacteria and cyanobacteria.

The organisms which have well defined nucleus and membrane bounded organelles in their cells are called eukaryotes. e.g. all animals and plants etc.

Q.45. What do you know about Protista?

Ans. It includes eukaryotic unicellular and simple multicellular organisms. There are three main types of protists.

(i) Algae (Plant like protists) (ii) Protozoans (Animal like protists) (iii) Fungi-like protists

Q.46. Define Science.

Ans. Science is the study in which observations are made, experiments are done and logical conclusions are drawn in order to understand the principles of nature.

Q.47. Define Socio-biology.

Ans. The branch of biology which deals with the study of social behaviour and communal life of living organisms.

Q.48. What do you know about Surgery?

Ans. In surgery, parts of body may be repaired, replaced or removed.

For example, removal of stones through Renal surgery, transplantation of kidney, liver etc.

Q.49. Define taxonomy. **(Lahore board 2012 G I)**

Ans. The branch of biology which deals with the study of scientific naming and the classification of organisms into groups and subgroups is called taxonomy.

Q.50. Define Tissue. Give examples.

Ans. A group of similar cells specialized for the performance of a common function. e.g. Xylem tissue, epithelial tissue.

Q.51. What do you know about Volvox?

Ans. Volvox is a green alga found in water that show colonial organization. Hundreds of volvox cells make a colony.

Q.52. Define Zoology.

Ans. The branch of biology which deals with the study of animals is called zoology.

SOLVING A BIOLOGICAL PROBLEM

Q.1. Define biological method. Explain its various steps involved in this method.

Ans. Biological Method:-

Definition

Any organized and systematic method which is used to resolve a specific biological problem is called biological method of study.

Or

"The scientific method in which biological problems are solved is called biological method."

Importance:

Biological method has contributed to the advancements in medicine, ecology, technology etc. Biological method also ensures the quality of data for public use.

Different steps of solving a Biological Problem

In order to resolve a specific biological problem, biologist takes following steps;

(i) Recognition of biological problem
(ii) Observations
(iii) Hypothesis formulation
(iv) Deductions
(v) Experimentations
(vi) Summarization of results (create tables, graphics etc.)
(vii) Reporting the results.

(i) Recognition of Biological Problem

The first step in biological method is to determine a biological problem. A biological problem is a query about living organisms that is either asked by someone or comes in biologist's mind by himself.

(ii) Observations

Observations are made with five senses of vision, hearing, smell, taste and touch.

Types of observations

Observations may be qualitative or quantitative.

Comparison of Quantitative and qualitative observations.

Quantitative observations are considered more accurate than qualitative observations because the former are invariable and measureable and can be recorded in terms of numbers.

Explanation

(a) Qualitative Observations

Definition

Qualitative observations are less accurate, variable and can't be measured. These represent the quality of substance e.g., beauty, intelligence etc.

- The freezing point of water is colder than the boiling point.
- A liter of water is heavier than a liter of ethanol.

(b) Quantitative Observations

Definition

These represent quantity which can be measured in term of numbers and are measurable and invariable.

- The freezing point of water is 0°C and the boiling point is 100°C.
- A liter of water weighs 1000 grams and a liter of ethanol weighs 789 grams.

(iii)Formulation of Hypothesis

Definition

Any suitable proposition that might be true is hypothesis.

OR

The tentative explanation of observations is called a **hypothesis.**

Characteristics of hypothesis

(a) It should be a general statement.

(b) It should be a tentative idea.

(c) It should agree with available observations.

(d) It should be kept as simple as possible.

(e) It should be testable and potentially falsifiable.

iv) Deductions

Definition

It is a logical conclusion drawn from hypothesis.

The deductions are tested through experiments.

Testing one deduction and finding it correct does not mean the hypothesis is correct but the validity of hypothesis is more supported if many deductions confirm the hypothesis.

v) Experiments

Experiments are designed to test the deduction. Biologists perform experiments to see hypotheses are true or not. For this purpose, experimental and control groups are formed.

Experimental group

The group of those who are affected in some way and we do not know the real cause e.g., a group of malarial patients.

Control Group

It is the group of unaffected people i.e. group of healthy persons in case of malaria.

vi) Summarization of Results

The biologist gathers actual and quantitative data from the experiments. To draw conclusions, the biologist also uses statistical analysis.

vii) Reporting the Results

Publishing of results in scientific journals and books is an essential part of the scientific method. It allows other people to verify the results or apply the knowledge to solve other problems.

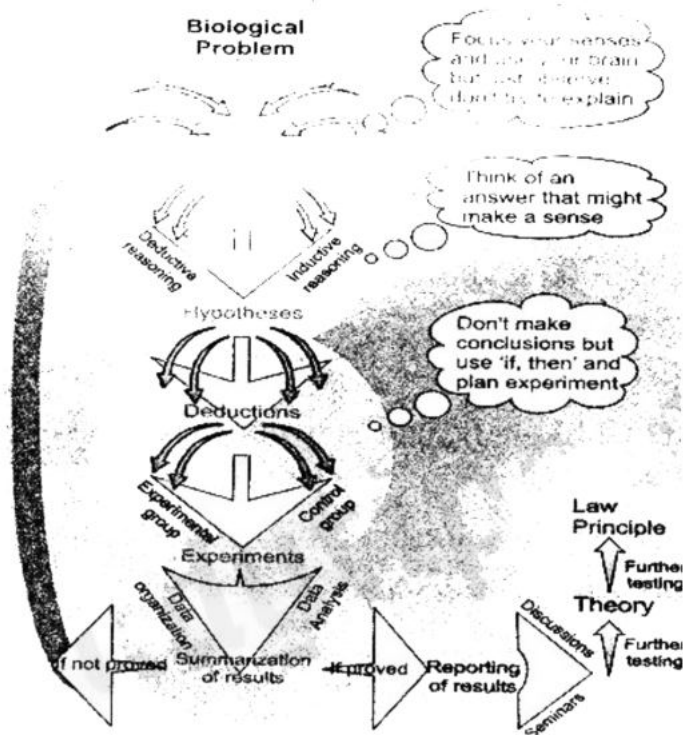



Figure 2.1: biological method

Q.2. Explain biological method with an example of malaria.

Ans. Observations about Malaria

(1) Disease of chills and fever

In ancient times, physicians were familiar with this disease. They described it as a disease of chills and fever with recurring attacks. They observed that the disease was more common among people living in low marshy areas.

(2) Association of malaria with marshy places

It was thought that the stagnant water of marshes poisoned the air and as a result of breathing in this "bad air", people got malaria. This belief lead to the name of disease "Malaria".

(3) Meaning of malaria

A combination of two Italian words. "The Italian word for "bad" is mala and "air" is aria".

(4) Marshes and Malaria

Some volunteers drank the stagnant water from the marshes. They did not develop malaria.

(5) Treatment of malaria by using cinchona bark

In 17th century, many plants from America were sent back to Europe to be used as medicines. The bark of a tree known as quina-quina was very suitable for curing fevers.

Some dishonest merchants began to substitute the bark of another tree; "cinchona" which closely resembled quina-quina. This dishonesty proved much valuable for mankind.

Cinchona bark was found to be excellent for treating malaria. Cinchona bark contains quinine that is effective in treating the disease.

(6) Work of Laveran

In 1878, a French army physician Lavern began to search for the cause of malaria. He took a small amount of blood from a malarial patient and examined it under microscope. He noticed some tiny living creatures. The organism was given a name "Plasmodium".

(7) Four major observations about malaria

1. Malaria and marshy areas have some relation.
2. Quinine is an effective drug for treating malaria.
3. Drinking the water of marshes does not cause malaria.
4. Plasmodium is seen in the blood of malarial patients.

Hypothesis

The hypothesis made regarding malaria was "Plasmodium is the cause of malaria".

Deduction

Following deduction is drawn from the above mentioned hypothesis. "If the Plasmodium is the cause of malaria then all persons ill with malaria should have Plasmodium in their blood".

Experiments

The next step was to test the deduction through experiments which were designed as:

(i) Experimental Group

Blood of 100 malarial patients was examined under microscope.

(ii) Control Group

Blood of 100 healthy persons was also examined under microscope.

Results

The results of the experiments showed that almost all malarial patients had Plasmodium in their blood while 7 out of 100 healthy persons had plasmodium in their blood. Now we know that Plasmodium in the blood of healthy people was in incubation period i.e. the period between the entry of Parasite in host and appearance of symptoms. The results were quite convincing and proved that the hypothesis "Plasmodium is the cause of malaria" was true.

Q.3. How Plasmodium gets into human body?

Ans.

It was the next biological problem. The biologists want to learn how plasmodium gets into the blood of man

(i) Observations .

Biologists had following observations:

- ❖ Malaria is associated with marshes
- ❖ Drinking water of marshes does not cause malaria

These observations show that plasmodium was not present in the marsh water. But it must be carried by something. That thing comes to marsh water.

(ii) Work of A.F.A.King **(Lahore board 2012 G I)**

In 1883, a physician A.F.A. King listed 20 observations some important observations of king were:

(iii)Observations of A.F.A King

- ❖ People who slept outdoors were more likely to get malaria than those who slept indoors.
- ❖ People who slept under fine nets were less likely to get malaria than those who did not use such nets
- ❖ An individual who slept near smoky fire usually did not get malaria.

(iv)King's Hypothesis

"Mosquitoes are involved in the spread of malaria".

(v) Deductions

Following deductions were made considering the hypothesis as true i.e; If mosquitoes are involved in the spread of malaria then;

Deduction 1

"Plasmodium should be present in mosquitoes".

Deduction 2

"A mosquito can get plasmodium by biting a malarial patient."

(vi) Experiments of Ronald Ross **(Lahore board 2012 G I)**

Introduction

In order to test the above deductions, Ronald Ross, a British army physician working in India in 1880's, performed important experiments.

Experiment No. 1

Ross allowed a female Anopheles mosquito to bite a malarial patient. He killed the mosquito some days later and found plasmodium multiplying in mosquito's stomach.

The next logical experiment was to allow an infected mosquito to bite a healthy person. If the hypothesis was true, the healthy person would have got malaria but scientists avoid using human beings for experiments.

Experiment No. 2

Ross used sparrows and redesigned his experiments. He allowed a female culex mosquito to bite on the sparrows suffering from malaria. Some of the mosquitoes were killed and studied at various times. In each mosquito, Ross found that plasmodium multiplied in the wall of mosquito's stomach and then moved into the mosquito's salivary glands.

`Experiment No. 3

Ross kept some mosquitoes alive in the second experiment and allowed them to bite healthy sparrows. Ross found that saliva of the infected mosquito contained plasmodium and these entered the sparrow's blood. When he examined the blood of these previously healthy sparrows, he found many plasmodium in it.

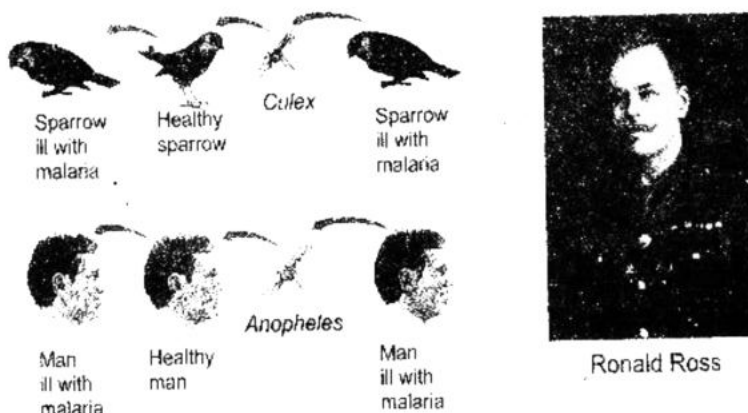



Figure 2.2: Malaria in sparrow and man is transmitted by Culex and Anopheles mosquitoes respectively

Conclusion

Ross concluded that similar relationship is found in mosquito and plasmodium.

(vii) Experiments on Man

In the end, the hypothesis that "mosquitoes transmit plasmodium and so are involved in the spread of malaria" was tested by direct experimentation on human beings. In 1898, some Italian Biologists allowed an Anopheles mosquito to bite a malarial patient. The mosquito was kept for a few days and then it was allowed to bite a healthy man. This person became ill with malaria. In this way, it was confirmed that mosquitoes transmit plasmodium and so are involved in the spread of malaria.

(viii) Theory: **(Lahore board 2012 G II)**

The hypothesis that stand the test of time (often tested and never rejected) is called theory. A theory is supported by a great deal of evidence.

(ix) Law and Principle: **(Lahore board 2012 G II)**

If a theory survives a doubtful approach and continues to be supported by experimental evidence, it becomes a law or principle. A scientific law is a uniform or constant fact of nature. It is an irrefutable theory. The examples of biological laws are Hardy Weinberg law and Mendel's law of inheritance.

Q.4. Explain the importance of data organization and data analysis in biological method.

Ans. Data Organization and Data Analysis

Data organization and data analysis are important steps in the biological method.

Data

Data can be defined as a single piece of information such as names, dates or values made from observations and experimentations.

Data Organization

In order to formulate and then to test the hypotheses, scientists collect and organize data. Prior to conducting an experiment, it is important for a scientist to describe the collection methods because it ensures the quality of experiments. Data is organized in different formats like graphics, tables, flow charts, maps and diagrams.

Data Analysis

Data analysis is necessary to prove or disprove a hypothesis by experimentation. It is done through the application of statistical methods.

Application of Statistical Methods

Depending on the type of data and the biological problem this might include application of statistical methods i.e.

(i) Ratio (ii) Proportion

(i) Ratio

Definition: When a relation between two numbers e.g. 'a' and 'b' is expressed in terms of quotient (a/b), it is called the ratio of one number two other.

Representation of Ratio

A ratio may be expressed by putting a division (÷) or colon (:) mark between two numbers.

Example

The ratio between 50 malarial patients and 150 normal persons is 1:3.

(ii) Proportion

Definition

Proportion means to join two equal ratios by the sign of equality (=).

Representation of Proportion

a : b = c : d or a : b :: c : d

Example

A biologist can calculate how many birds would get malaria, when he allowed infected mosquitoes to bite 100 healthy sparrows. In one experiment he noted that when he allowed mosquitoes to bite 20 sparrows, 14 out of them got malaria. By using proportion rule:-

X : 100 :: 14 : 20

$$\frac{X}{100} = \frac{14}{20} \Rightarrow X \times 20 = 14 \times 100$$

$$\Rightarrow X = \frac{100}{20} \times 14 \Rightarrow X = 70.$$

It means 70 out of 100 sparrows would get malaria.

Statistics

Statistics are thus a means of summarizing data through the calculation of a mean value. This step is very important as it transforms raw data into information which can be used to summarize and report the results.

Q.5. Mathematics as an integral part of scientific process. Explain briefly.

Ans. Biological method also involves the use of applied mathematics to solve biological problems. Major biological problem in which knowledge of mathematics is used including gene finding, protein structure and protein-protein interaction.

Bioinformatics

Bioinformatics refer to the use of computational and statistical techniques for the analysis of Biological problem.

Multiple Choice Questions

1. Which one of the following is correct sequence in biological method?
(a) Observations, Hypothesis, Law, Theory
(b) Hypothesis, Observations, Deduction, Experimentation
(c) Observations, Hypothesis, Deduction, Experimentation
(d) Law, Theory, Deduction, Observations

2. Which one of these is not a characteristic of a hypothesis?
(a) Must be consistent with all available data
(b) Must be testable
(c) Must be correct
(d) Must make predictions

3. At which point, is a biologist most likely to use reasoning?
(a) While taking observations
(b) During hypothesis formulation
(c) During data organization
(d) None of the above.

4. A hypothesis must be testable to be scientifically valid. Being testable means that:
(a) Some observations could prove that hypothesis is incorrect
(b) Only a controlled experiment can indicate whether the hypothesis is correct or incorrect
(c) The hypothesis is proven wrong
(d) The opposite of hypothesis is tested and proven wrong

5. What would be the best experimental design for testing a hypothesis that bean plants require sodium?
(a) Measure the amount of sodium in a few bean plants
(b) Grow bean plants with and without sodium
(c) Look for sodium in leaf tissues
(d) Analyze root contents for sodium

6. A gardener sees a large snake nearby. He knows generally snakes sting, so

the gardener ran away. The gardener did which of the following?

(a) Used reasoning

(b) Used observation

(c) Constructed a theory

(d) Tested a hypothesis

7. A scientific theory has which of the following properties?

(a) It agrees with the available evidence

(b) It cannot be rejected

(c) It has been absolutely proven

(d) It does not need to be altered in the light of new evidences

8. Experimentation is only a step of the scientific process but it is very important step because it always:

(a) Gives the biologist a correct result

(b) Allows rejection of some alternative hypothesis

(c) Ensures that hypothesis can be confirmed with certainty

(d) Give scientists a chance to work in the laboratory

9. You are testing a hypothesis; "students learn more if they drink tea before sitting for study". Your 20 experimental students drink tea before study;

You test their learning by giving question. Your 20 students of the control group should have all experimental conditions identical to the experimental group EXCEPT that;

(a) They should take tea

(b) They should take tea before as well as during study

(c) They should not take tea before studying

(d) They should not sit for studying

10. When A.F.A King did work on Malaria?

(a) 1880 (b) 1881

(c) 1882 (d) 1883

11. The scientist who observed Plasmodium first time in human blood is:

(a) Aristotle (b) Bu-Ali-Sina

(c) Laveran (d) None of these

12. Which mosquito spread malaria in birds.

(a) Anopheles (b) Culex

(c) Anopheles & Culex

(d) None of these

13. Five senses are involved in:

(a) Hypothesis (b) Observations

(c) Deduction (d) Experiment

14. Logical consequence of hypothesis is:

(a) Experiment (b) Deduction

(c) Observation (d) theory

15. Which is the quantitative observation

(a) colour (b) smell

(c) beauty (d) height

16. Which of the followings is the symptom of malaria?

(a) Chills (b) Fevers

(c) Recurring attacks (d) All

17. Quinine is obtained from:

(a) quina - quina (b) Deodar

(c) Cinchona (d) shisham

18. Bark of quina – quina was imported from:

(a) Europe (b) America

(c) Spain (d) India

19. Plasmodium was first seen by:
(a) Ross (b) A.F.A.King
(c) Laveran (d) None

20. Plasmodium was named by:
(a) Ross (b) A.F.A.King
(c) Laveran (d) None

21. Who performed experiments on sparrow?
(a) Ross (b) A.F.A.King
(c) Laveran (d) None

22. No of steps of biological method are:
(a) Seven (b) Six
(c) Two (d) Eight
(Lahore board 2011 G II)

23. A scientific law is an irrefutable:
(a) observation (b) Theory
(c) Principle (d) None of these
(Lahore board 2011 G I)

Answers											
1.	c	3.	b	5.	b	7.	c	9.	c	11.	c
2.	b	4.	b	6.	a	8.	c	10.	d	12.	b
13.	b	14.	b	15.	d	16.	d	17.	c	18.	b
19.	c	20.	c	21.	a	22	a	23	b		

Short Questions

Q1. What is Bioinformatics?

Ans. Bioinformatics refers to the use of computational and statistical techniques for the analysis of biological data.

Q2. Define Biological Method. (Lahore board 2012 G II)

Ans. The scientific method in which biological problems are solved is termed as biological method.

Q3. Define Biological Problems.

Ans. The question which is related to living things are called biological problem that is either asked by someone or comes in biologist's mind by himself.

Q4. What is the difference between control group and experimental group?

Ans. Control group is the group of people who are unaffected. For example the group of healthy persons will be called a control group.

Group of those persons who are affected with some disease and we do not know the real cause e.g. Group of malarial patients.

Q5. Define Deduction. **(Lahore board 2012 G II)**

Ans. The logical conclusion drawn from hypothesis is called deduction e.g., the deduction made about malaria from hypothesis was "If plasmodium is the cause of malaria then all persons ill with malaria should have plasmodium in their blood."

Q6. Define Experiments and describe its types.

Ans. Experiments are designed to test the deduction. For this purpose, experimental and control groups are formed. Two groups are always made in experimentation:

(i) Control group (ii) Experimental group

Experimental Group:

The group of those persons who are affected in some way and we do not know the real cause e.g. persons suffering from any disease.

Control Group:

It is the group of unaffected people i.e. group of healthy persons.

Q7. Define Hypothesis. **(Lahore board 2011 G I)**

Ans. The tentative explanation of the observation is called a hypothesis e.g., hypothesis made about malaria was "Plasmodium is the cause of malaria".

Q8. Differentiate between Law and Theory.

Ans. Law

If a theory survives doubtful approach and continues to be supported by experimental evidence, it becomes a law.

Theory

The hypothesis that stands the test of time (often tested and never rejected) is called theory. A theory is supported by a great deal of evidence.

Q9. Define observations. What are their types?

Ans. Observations are made with five senses of vision, hearing, smell, taste and touch.

Types of observations

Observations may be both qualitative and quantitative.

Quantitative Observations

Quantitative observations are considered more accurate than qualitative ones because these are invariable and measureable and can be recorded in terms of numbers.

Qualitative Observations

Qualitative observations are less accurate, variable and cannot be measured e.g., beauty, intelligence.

Q10. What is the association of anopheles mosquito with humans?

Ans. It is a female mosquito which transfers plasmodium from one person to another and it plays an important role in spreading the malaria in humans

Q11. Why Cinchona bark is important in biologist's mind for treating malaria?

Ans. Cinchona is a plant and the biologists get Quinine from the bark of cinchona.

Q12. What is Plasmodium?

Ans. Plasmodium is a microscopic parasitic protozoan which causes malaria. It completes its sexual phase of life cycle in mosquitoes and asexual phase in the body of human.

Q13. What do you know about Quina Quina?

Ans. This is a plant which is found in America. Initially, the bark of Quina Quina was used in the treatment of fever.

Q14. What is incubation period?

Ans. The period in between the entry of plasmodium parasite in human body and appearance of symptoms of malaria is called incubation period.

Q15. What are the characteristics of a good hypothesis? (Lahore board 2011-12 G I)

Ans. 1. It should be a general statement.

2. It should be a tentative idea.
3. It should agree with available observations.
4. It should be kept as simple as possible.
5. It should be testable and potentially falsifiable.

Q16. Why welts appear after biting mosquito?

Ans. The welts that appear after mosquito bites is not a reaction to the wound but an allergic reaction to the saliva. In most cases, the itching sensation and swelling subside within several hours.

Q17. Write major observations about malaria.

Ans. 1. Malaria and marshy areas have some relation.

2. Quinine is an effective drug for treating malaria.
3. Drinking water of marshes does not cause malaria.
4. Plasmodium is seen in the blood of malarial patients.

Q18. Define Science.

Ans. Science is the systematized knowledge derived from observations and experiments.

Q19. What are the observations of A.F.A. King?

Ans.

1. People who slept outdoors were more likely to get malaria than those who slept indoors.
2. People who slept under fine nets were less likely to get malaria than those who did not use such nets.
3. People who slept near a smoky fire usually did not get malaria.

Unit 03

BIODIVERSITY

Q.1. What is biodiversity? Explain distribution and importance of biodiversity?

Ans. The term biodiversity has been derived from bio and diversity. Bio means life and diversity means variety within and among species.

Definition

"Biodiversity is a measure of the variety of organisms present in different ecosystems".

Dependence of biodiversity

Plants and animals (flora and fauna) diversity depends on:

(i) Climate

(ii) Altitude

(iii) Soil

(iv) Presence of other species

Figure 3.1: Variety of plant life in a tropical (left) and temperate (right) region

Distribution of biodiversity

Biodiversity is not distributed evenly on Earth.

1. Tropical regions

Biodiversity is the richest in the Tropics.

2. Temperate regions

Temperate regions also have many species.

3. Polar Regions

Fewer species are present in Polar Regions.

Biodiversity found on Earth today is the result of 4 billion years of evolution. All life consisted of bacteria and similar unicellular organisms.

Figure 3.2: Variety of animal life in Polar Regions

Importance of Biodiversity

Source of Food

Biodiversity provides food for humans.

Source of Drugs

A significant proportion of drugs are derived directly or indirectly, from biological sources.

Source of Industrial Materials

A wide range of industrial materials e.g. building materials, fibres, dyes, resins, gums, adhesives, rubber and oil are derived directly from biological resources.

Maintenance of Ecosystem

Biodiversity plays an important role in making and maintaining ecosystems. It plays a part in regulating the chemistry of our atmosphere and water supply.

Recycling of Nutrients

Biodiversity is directly involved in recycling nutrients and providing fertile soils.

Q.2. What is classification? Describe the aims and the basis of classification.

Ans. Definition

The arrangement of organisms into groups and subgroups on the basis of similarities and differences is called classification.

Known Number of animals and plant species:

Over 1.5 million types of animals and over 0.5 million types of plants are known to biologists.

Size

They range in complexity from small and simple bacteria to large and complex human beings.

Habitat

Some of the organisms live in sea, some on land, some walk, others fly and still others are stationary.

Need of classification:

Each species has its own way of life. When there are so many kinds of organisms, biologists classify the organisms to study such a large collection in an easy way.

Taxonomy

The branch of biology which deals with scientific naming and classification of organisms is called taxonomy.

Systematics

The branch which deals with classification and also traces the evolutionary history of organisms is known as systematics.

Aims of Classification: The main aims of classification are:

(i) To determine similarities and differences among organisms so that they can be studied easily.

(ii) To find the evolutionary relationships among organisms.

Basis of Classification: Classification is based on relationship among organisms and such relationship is got through similarities in the form or structure.

These similarities are seen in:-

1. Structures (both external and internal)
2. Biochemistry
3. Modern Genetics

These similarities suggest that all organisms are related to one another at some point in their evolutionary histories. However, some organisms are more closely related than others. For example; sparrows are more closely related to pigeons than to insects. It means sparrows and pigeons have common evolutionary histories.

Q.3. What is taxonomic hierarchy?

Ans. Taxa

The groups into which organism are classified are known as taxonomic categories or taxa.

Taxonomic Hierarchy

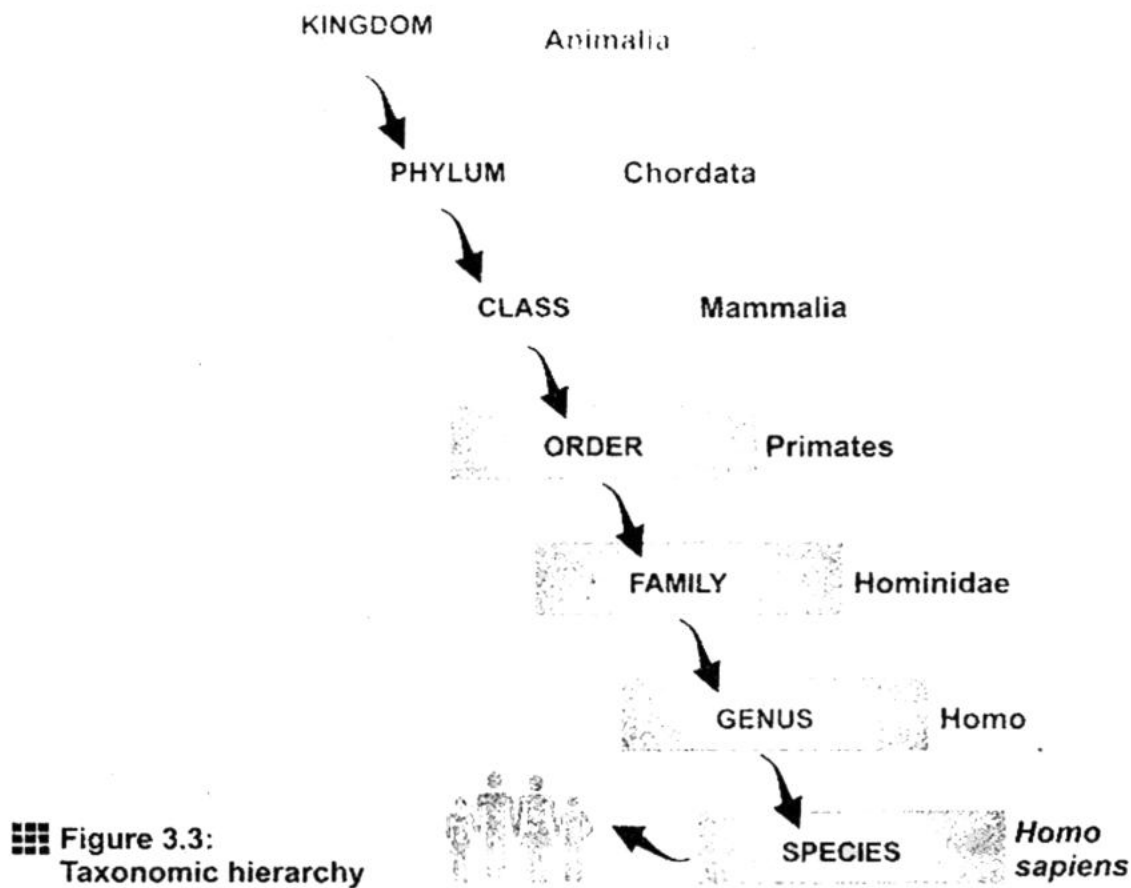
The taxa form a ladder called taxonomic hierarchy.

All the organisms are divided into five kingdoms. So kingdom is the largest taxon. On the basis of similarities, each kingdom is further divided into smaller taxa in the following way:

Phylum: A phylum is a group of related classes.
Class: A class is a group of related orders.
Order: An order is a group of related families.
Family: A family is a group of related genera.
Genus: A genus is a group of related species.
Species: A species consists of similar organisms.

Table 3.1 Simple classification of two organisms

Taxa	Human	Pea
Kingdom	Animalia	Plantae
Phylum / Division	Chordata	Magnoliophyta
Class	Mammalia	Magnoliopsida
Order	Primates	Fabales
Family	Hominidae	Fabaceae
Genus	*Homo*	*Pisum*
Species	*H. sapiens*	*P. sativum*

Figure 3.3: Taxonomic hierarchy

Q.4. Define Species. Give two exceptions for the species concept.

Ans. Species-the basic unit of classification

"A species is a group of organisms which can interbreed freely among them and produce fertile offsprings but are reproductively isolated from all other such groups in nature". Each species has its own distinct structural, ecological and behavioural characteristics.

Two Exceptions for the species concept

(i) Artificial Cross Breeding

In the definition of species we must emphasize in nature because two organisms related to two different but closely related species can cross breed under artificial conditions. In such unnatural crosses, they produce infertile offspring. A cross between a male donkey and a female horse produces an infertile offspring, the mule.

Figure 3.4: Infertile Mule

(ii) Organisms with asexual reproduction

The criteria of interbreeding cannot be used for species recognition in organisms who reproduce asexually and don't interbreed with one another e.g, many unicellular organisms.

Q.5. Describe the history of classification system.

Ans. History of classification system

Aristotle: The earliest known system of classification of organisms comes from the Greek philosopher Aristotle who classified organisms into two groups, 'plantae' and 'animalia'.

i. Abu Usman Umer Aljahiz

In 700s, Abu Usman Umer Aljahiz described the characteristics of 350 species of animals in his book. He wrote a lot about the life of ants.

ii. Ibn Rushd: In 1172, Ibn Rushd (Averroes) translated Aristotle's Book "De Anima" (on the soul) into Arabic.

iii. Andrea Caesalpino (1519-1603 AD)

He was an Italian botanist and proposed the first methodical arrangement of plants. He divided plants into fifteen groups called "Genera."

iv. John Ray (1627-1705 AD)

An English naturalists, John Ray published important works on plants' classification.

v. Augustus Rivinus (1652–1723 AD)

He introduced the taxon of order:

vi. Tournefort (1656 – 1708 AD)

He introduced the taxa of "class and species".

vii. Carolus Linnaeus (1707 – 1778 AD) **(Lahore board 2012 G II)**

Modern classification has its root in the work of Linnaeus who grouped species according to the similar physical characteristics. He divided nature into three kingdoms: mineral, vegetable and animal. He also used five ranks in classification.

Q.6. Describe the two Kingdom system of classification. **(Lahore board 2011 G I)**

Ans. It is the oldest system and classifies all organisms into two Kingdoms i.e, plantae and animalia.

Plantae: All organisms that can prepare food from simple inorganic materials and thus can store energy are autotrophs. According to this system bacteria, fungi and algae were included in kingdom plantae.

Animalia: The organisms that cannot synthesize their food and depend on autotrophs or others are heterotrophs and are included in kingdom animalia.

Objection/Drawbacks

(i) Some taxonomists found this system unworkable because many unicellular organisms like Euglena have both plant-like (Presence of Chlorophyll) and animal-like (Heterotrophic mode of nutrition in darkness and lack cell wall) characters. So, there should be a separate kingdom for such organisms.

(ii) This system also ignores the difference between organisms having prokaryotic and those having eukaryotic cells.

Q.7. Describe the three Kingdom Classification System.

Ans. In 1866, Ernst Hackel solved the first objection and proposed a third kingdom, protista, for the placement of Euglena like organisms. He included a kingdom protista. In this system, fungi were still in the kingdom plantae.

Objection/Drawbacks

(i) This system did not clear the difference between prokayotes and eukaryotes.

(ii) Some biologists disagreed about the position of fungi in kingdom plantae. Fungi resemble plants in many ways but are not autotrophs. They are special form of heterotrophs that get their food by absorption. They do not have cellulose in their cell walls rather possess chitin.

Q.8. Describe the five kingdom system of classification.

Ans. Work of E-Chatton

In 1937, E-Chatton suggested the term "Procariotique" to describe bacteria and "Eucariotique" to describe animals and plant cells.

Work of Robert Whittaker

In 1967, Robert Whittaker introduced the five-kingdom classification system. This system is based on:

(i) The levels of cellular organizations: i.e., prokaryotic, unicellular eukaryotic and multicellular eukaryotic.

(ii) The principal modes of nutrition: i.e. photosynthesis, absorption and ingestion.

On this basis, organisms are classified into five kingdoms: named, monera, protista, fungi, plantae and animalia.

Modification of the five Kingdom Classification System

In 1988, Lynn Margulis and Karlene Schwartz modified the five kingdom classification of Whittaker by considering genetics along will cellular organization, mode of nutrition, in classification.

The Five Kingdom Classification system:-

The general characteristics of five kingdoms are as follows:

Kingdom Monera **(Lahore board 2012 G I)**

(i) It includes prokaryotic organisms i.e. they are made of prokaryotic cells.

(ii) Moneras are unicellular, although some type form chains, clusters or colonies of cells.

(iii)Prokaryotic cells are radically different from eukaryotic cells.

(iv)They are heterotrophic but some perform photosynthesis because they have chlorophyll in their cytoplasm.

(v) In this kingdom, there are two different kinds of organisms i.e. bacteria and cyanobacteria.

Kingdom Protista:

It includes eukaryotic unicellular and simple multicellular organisms.

There are three main types of Protists:-

(i) Algae: They are unicellular, colonial or simple multicelllar. Simple multicellular means that they do not have multicellular sex organs and do not form embryos during their life cycles.

(ii) Protozoans resemble animals whose cells lack chlorophyll and cell walls.

(iii) Fungi like Protists: Some protists are like the fungi.

Kingdom Fungi

(i) It includes eukaryotic multicellular heterotrophs e.g.. mushrooms.

(ii) Fungi are heterotrophic organisms that are absorptive in their nutritional mode.

(iii) Most fungi are decomposers.

(iv) They live on organic materials, secrete digestive enzymes and absorb small organic molecules formed by the digestive enzymes.

Figure 3.5: The Five kingdoms of classification

Kingdom Plantae

(i) It includes Eukaryotic multicellular autotrophs.

(ii) Plants are autotrophic in nutritional mode, making their own food by photosynthesis.

(iii) They have multicellular sex organs and form embryos during their life cycles.

(iv) Mosses, Ferns and flowering plants are included in this kingdom.

Kingdom Animalia

(i) It includes eukaryotic multicellular consumers.

(ii) Animals live mostly by ingesting food and digesting it within specified cavities.

(iii) They lack cell wall and show movements.

Table 3.2 Distinguishing characteristics of five kingdoms of life

Kingdom	Cell Type	Nuclear Envelope	Cell Wall	Mode of Nutrition	Multi Cellularity
Monera	Prokaryotic	Absent	Non-cellulose (polysaccharides and amino acids)	Autotrophic or heterotrophic	Absent
Protista	Eukaryotic	Present	Present in some forms, various types	Photosynthetic or heterotrophic	Absent in most forms

				ot combination	
Fungi	Eukaryotic	Present	Chitin	Absorptive heterotrophs	Present in most forms
Plantae	Eukaryotic	Present	Cellulose	Photosynthetic	Present in all forms
Animalia	Eukaryotic	Present	Absent	Ingestive heterotrophs	Present in all forms

Q.9. What do you about the status of viruses? Describe briefly about the prions and viroids also.

Ans. Status of Viruses **(Lahore board 2011 G II)**

Viruses are acellular i.e. they do not possess cellular organizations yet show some characters of living things. Due to their crystalline structure, they are considered as non-living. They are not considered as organisms and thus are not included in five Kingdom Classification System. The branch of biology in which we study viruses is called virology.

Structure

Viruses contain either DNA or RNA normally encased in protein coat and reproduce only in living cells where they cause a number of diseases.

Prions

Prions are composed of protein only and act as infectious particles in plants. These are acellular particles and are not included in five Kingdom Classification System.

Viroids

Viroids are acellular in nature and composed of circular RNA only and act as infectitious particles and cause diseases in certain plants. They are not included in five Kingdom Classification System.

Q.10. What is meant by binomial nomenclature? Describe its rules and significance.

Ans. Introduction of binomial nomenclature.

It was introduced by Swedish biologist Carolus Linnaeus (1707-1778). His system spread rapidly. It became popular. Many of his names are in use today.

Definition: Binomial nomenclature is the method of giving scientific names to living organisms.

Explanation: The scientific names of a species consist of two names:

Genus: The first is the genus name.

Species: The second one is the name of the species.

Rules of Binomial Nomenclature:-

(i) Scientific names are usually printed in italics, such as *Homo sapiens*. When handwritten, they should be underlined as Homo sapiens.

(ii) The first term (generic name) always begins with capital letter while the species name is never capitalized (even when derived from a proper name).

(iii) The scientific name should generally be written in full when it is first used but when several species from the same genus are being listed, it may then be abbreviated by just using an initial for genus. For example, *Escherichia coli* becomes *E. coli.*

Significance of binomial nomenclature

Problems caused by common names

Common names cause many problems.

(i) Many names for the same organisms

Various regions have different names for the same organisms e.g. The common name of Onion in Urdu is Piyaz, but in different regions of Pakistan it is also known as Ganda, Bassal or Vassal. In other countries, it has other sets of names. In science, it is known with a single name as *Allium cepa*.

(ii) Same names for many organisms

In some cases, several organisms are called by the same common name: For example; 'Black bird is used for crow as well as for raven.

(iii) Common name without scientific basis

Common names have no scientific basis. e.g. a fish is vertebrate animal.

It has fins and gills. But there are several common names like 'silverfish', 'crayfish', 'Jellyfish' and 'Starfish'. They do not fit the biologist's definition of a fish.

Advantages

(i) To avoid all these confusions, organisms are given scientific names by using binomial nomenclature.

(ii) This system has great value and stability of its names. It has widespread use.

(iii) Every species can be unambiguously identified by binomial nomenclature. It requires just two words.

(iv) The same name can be used all over the world, in all languages. It avoids the difficulties of translation. e.g.

Examples:

Common Name	**Scientific Names**
Onion	*Allium cepa*
Common sea star(starfish)	*Asterias rubens*
House crow	*Corvus splendens*

Q.11. Describe conservation of biodiversity. Also write down impact of human beings on biodiversity.

Ans. Impact of human population on extinction

During the last century, loss of biodiversity has been increasingly observed. We now know that the most species that ever lived had gone extinct. In modern era, due to human actions, species and ecosystems are threatened with destruction to an extent rarely seen in Earth history.

Types of Species

(i) Extinct Species **(Lahore board 2011 G I)**

A species that no longer lives anywhere on Earth is said to be extinct.

Effect of Extinction of species

When the species of an ecosystem becomes extinct, the stability of ecosystem is harmed. Biologists warn that the global ecosystem collapse if it is further reduced in complexity.

(ii) Endangered Species

A species is called endangered if it is at the risk of extinction in near future.

Examples of extinct and endangered species

Many plant and animal species have become extinct in Pakistan. Examples of endangered and extinct animal species are lion, tiger, Asiatic Cheetah, Indian one horned rhinoceros, swamp deer, Indian wild ass, hangul, blackbuck etc.

Impact of Human beings on Biodiversity. **(Lahore board 2011 G I)**

There were about 5 million people on earth in the beginning. Now we have 600 million people. To improve the living conditions, we are imposing serious threats to the survival of biodiversity.

Factors leading to loss of biodiversity

Following are the factors contributing the loss of biodiversity

(i) Overpopulation **(ii)** Deforestation **(iii)** Overhunting

(iv) Introduction or removal of new species,

(v) Pollution and climate change.

(vi) Habitat loss: It is probably the greatest threat to biodiversity on Earth today.

All these factors are secondary to over-population.

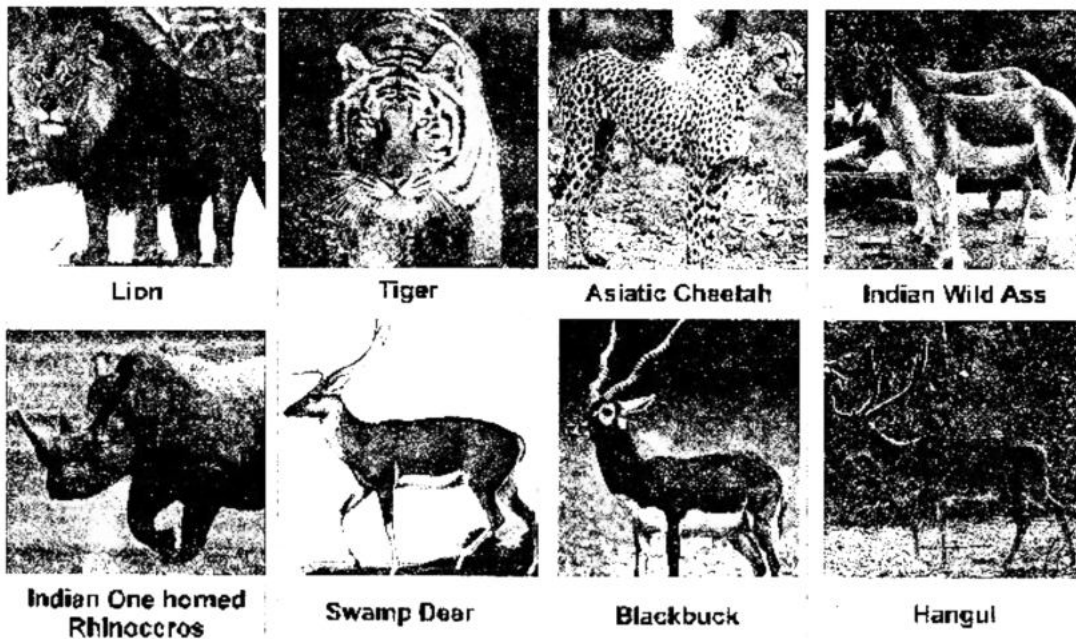



Figure. 3.6: The animals that have gone extinct in Pakistan.

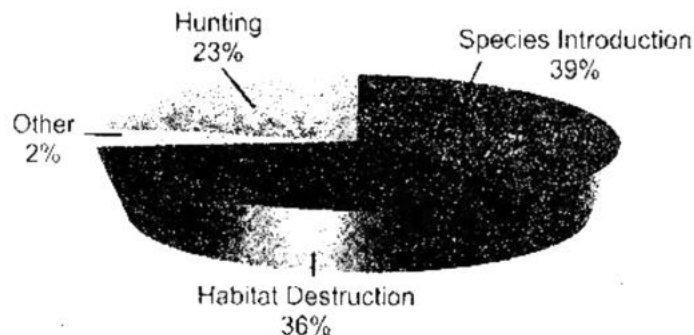
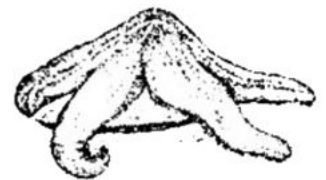



Figure 3.7: Known causes of species extinctions
(Source: World Conservation Monitoring Centre)

Q.12. What is the effect of removal of species.

Ans. Sea star eats mussels. If sea stars are removed from a region in ocean, mussels rapidly increase in number. Large number of mussels prey on small animals and become dangerous for their existence.

Sea Star

Q.13. What is the effect of introduction of species.

Ans. Introduction of species

Eucalyptus plants were imported from Australia and introduced in Pakistan. These plants consume more water and have disturbed the water table. In this way, they harm other small plants that grow near them.

Eucalyptus plants

Q.14. Define deforestation. Describe its causes and effect.

Ans. Deforestation means cutting down of trees for the conversion of a forest to non-forest land. There is destruction of significant areas of forest. It has degraded environment with reduced biodiversity.

Causes of Deforestation

(i) Urban Development: Sometimes, there is slow forest degradation. But sometimes, there is sudden and catastrophic cutting of trees for urban development.

(ii) Cultivation: Deforestation may be the result of deliberate removal of forests for wood, agriculture or urban development. e.g. houses, Roads, Buildings etc.

Effects of Deforestation

(i) Degradation of Environment: Deforestation has resulted in a degraded environment with reduced biodiversity.

(ii) **Amount of water and moisture:** Deforestation affects the amount of water and moisture in the atmosphere.

(iii) Soil Erosion: Trees keep the soil in place. When there are no trees to keep the soil in place, the soil becomes ripe for erosion.

(iv) Source of Flood: Due to deforestation, there is less protection from wind and rain. Heavy rainfall washes the soil into the rivers. Essential nutrients are washed out of the soil. Rivers become choked up with mud and silt, which can cause flood. This silted water gets stored in dams and it reduces their water storage capacity and life there is also harmed.

(v) Reduction in the sources of Rains: Deforestation decreases the transpiration which lessens cloud formation and humidity. This ultimately reduces the sources of rains.

Figure 3.8: Soil erosion

Figure 3.9: Chopping up of trees for the construction of road

Advantages of Forests

(i) Support to Biodiversity

Forests support considerable to biodiversity and provide valuable habitat for wild life.

(ii) Source of Medicinal Conservation

Forests act as medicinal conservation.

(iii) Utilization of forest's products

There is utilization of many forest products. There is use of timber and fuel wood. This use has played a key role in human societies. This is comparable to the roles of water and land.

(iv) Source of Timber

Today developed countries are using timber for building houses. They use the wood pulp for making paper. The forest products industry is a large part of the economy in both developed and developing countries.

(i) Loss of long term income: Short term economic gains made by conversion of forest to agriculture land often leads to loss of long-term income.

(ii) Contribution to Biosphere Stability: Forests extract carbon dioxide and pollutants from the air thus contributing to biosphere stability.

(iii)Source of Beauty: Forests are also source of aesthetic beauty and tourist attraction.

Threat to Biodiversity

In Pakistan too, deforestation is a great threat to biodiversity. The closed canopy forests are shrinking at approximately 1% per year in the province Khyber Pakhtunkhwa.

Q.15. What do you know about over hunting?

Ans. Over hunting has been a significant cause of the extinction and endangerment of hundreds of species. Commercial hunting is the principal threat.

Q.16. Define conservation. Explain conservation of biodiversity.

Ans. Conservation

Conservation means the protection of all those things that affect directly or indirectly on the life on earth. It includes:-

(i) Maintenance of the environment

(ii) Maintenance of the balance between human needs and resources.

(iii) Providing protection to the wild life

Explanation

(i) The conservation of biodiversity has become a global concern.

(ii) Biologists urge the national policy makers to state a set of rules necessary to protect an individual species. They demand that the laws should define species, which are threatened by extinction and must be protected. Countries should be loyal to conserve biodiversity and should develop resources for its sustainability.

Threats to Biological Resources in Pakistan

Pakistan is rich in biodiversity but faces severe threats to its biological resources. The greatest concern is the continuous loss of species and natural habitats.

Causes of loss of species and habitats

(i) Rapid growth in human population.

(ii) Prevailing (means spreading) poverty in the rural areas of Pakistan.

(iii) Low literacy rate

(iv) Less Resources

IUCN & WWF-P

The International Union for the Conservation of Nature and Natural resources (IUCN) and the World Wild life Fund Pakistan (WWF-P) work in close coordination with Pakistan's Ministry of environment and other government and non-government institutions. The IUCN has prepared the first national Red List (List of endangered or threatened species)

Organizations/Projects work to conserve species and habitat:

(i) **National Conservation Strategy:** In 1980's, the IUCN and the government of Pakistan formulated the National Conservation Strategy for Pakistan for the conservation of Pakistan's biodiversity.

(ii) **UN Convention on Combating Desertification (CCD):** This is an international treaty against the damage and poverty in drylands. Pakistan signed this in 1997.

(iii) **Himalayan Jungle Project (HJP):** It started in 1991in the Palas Valley, Khyber pakhtunkhwa (KP). It aimed at protecting one of the richest areas of biodiversity in Pakistan.

(iv) **Conservation of biodiversity of the Suleiman Range, Balochistan:** The Suleiman range of Chilghoza forest is the largest Chilghoza forest in the world. In 1992, the WWF-P started its conservation program.

(v) **Northern Areas Conservation Project:** The northern areas of Pakistan serve as a habitat for a number of wildlife species. The survival of these species is under threat. The NACP is a project of WWF-P, which is successful in implementing a ban on the hunting of these species.

(vi) **Conservation of migratory birds in Chitral, KP:** Chitral lies on the migratory route of several important bird species. These bird face enormous hunting pressure. WWF-P Pakistan initiated efforts to reduce the hunting pressure in 1992. These efforts proved successful.

(vii) **Conservation of Chiltan Markhor:** Hazarganji National Park is located close to Quetta and is the only remaining habitat of Chiltan Markhor in the country. WWF-Pakistan developed the management plan of the park. Markhor is National animal of Pakistan.

(viii) **Ban on games:** Foreigners visit the northern areas and play many games in which bears are used. WWF-Pakistan has been successful in imposing a ban on this illegal practice

Q.17. Write a note on Endangered species in Pakistan.

Ans. Indus Dolphin **(Lahore board 2011 G I)**

Introduction: The Indus river dolphin is a fresh water river mammal.

Habitat: It lives in Indus River.

Total Number. of Animals (Present Status)

According to WWF-P, only 600 animals of this species are left today in the Indus river in Pakistan.

Factors causing decline of species

(i) Water pollution (ii) Poaching (iii) Destruction of habitat.

Marco Polo Sheep

Habitat

In Pakistan, they are mostly found in the Khunjerab National Park and adjoining areas.

Endangered Status

The sheep have an endangered status and their numbers have been rapidly decreasing in the last two decades.

Conservation

WWF-P has started projects for its conservation.

Houbara bustard

Migratory Bird

Houbara bustard are migratory birds that fly to Pakistan in winter season from former soviet territory.

Settlement and Decline of the bird

Large number of these birds settles down in Cholistan and Thar deserts. The decline in the number of Houbara bustard is due to hunting by foreigners and destruction of its habitats.

Figure 3.10: Indus Dolphin, Houbara and Marco Polo Sheep – the endangered species

Multiple Choice Questions

1. Genus of Pea is;
   (a) Homo (b) Amanita
   (c) Escherichia (d) Pisum
2. Three kingdom Classification system was proposed in:
   (a) 1866 (b) 1937
   (c) 1688 (d) 1788
3. Which is composed of only protein?
   (a) Viruses (b) Prions
   (c) Viroids (d) 'b' and 'c'
4. Important cause of species extinctions is:
   (a) Habitat loss
   (b) Deforestation
   (c) Over population
   (d) Both 'a' and 'b'
5. Which one is the national bird of Pakistan?
   (a) Pigeon (b) Ostrich
   (c) Crow (d) Chakor
6. Cutting down of trees is known as:
   (a) Habitat loss (b) Deforestation
   (c) Extinction (d) None of these
7. Which one is acellular?
   (a) Bacteria (b) Fungi
   (c) Cyanobacteria (d) Viruses
8. Cell wall of fungi is made up of:
   (a) Cellulose (b) Amino acid
   (c) Chitin (d) 'a' and 'b'
9. Basic unit of classification is:
   (a) Genus (b) Order
   (c) Family (d) Species
   (Lahore board 2011 G II)
10. Classification means the grouping of organisms on the basis of:
    (a) How they feed
    (b) The features they have in common
    (c) How they respire
    (d) How they can survive
11. The kingdom protista includes:
    (a) Unicellular and simple multicellular organisms with membrane bounded nucleus
    (b) True multicellular organisms with no distinct membrane bounded nucleus.
    (c) True multicellular organisms with membrane bounded nucleus.
    (d) Unicellular organisms with no distinct membrane bounded nucleus.
12. Viruses are not classified in any kingdom because:
    (a) They are too poorly understood
    (b) They are too small
    (c) Their genetics cannot be determined
    (d) They are not considered organisms
13. Viruses are assigned to the kingdom:
    (a) Monera (b) Protista
    (c) Fungi (d) None of above
14. A related group of genera comprises:
    (a) An order (b) A family
    (c) A class (d) A phylum
15. In which kingdom, would you classify unicellular eukaryotes?
    (a) Fungi and Protists
    (b) Fungi and Monera
    (c) Only Protista
    (d) Only Fungi

16. In binomial nomenclature, the first letter of the __________ name is capitalized.

(a) Family (b) Class
(c) Species (d) Genus

17. Which one of the following sequences shows the correct hierarchy of classification, going from the smaller to the bigger group?

(a) Kingdom, Phylum, Order, Class, Family, Genus, Species
(b) Kingdom, Phylum, Class, Order, Family, Genus, Species
(c) Genus, Species, Kingdom, Phylum, Order, Class, Family
(d) Species, Genus, Family, Order, Class Phylum, Kingdom.

18. Which of the following may be the correct way of writing the scientific name of an organism?

(a) *Canis lupis* (b) Saccharum
(c) Grant's gazelle (d) E. Coli

19. A certain organism is multicellular, adapted for photosynthesis and has multicellular sex organs. To which kingdom does it belong?

(a) Animalia (b) Fungi
(c) Plantae (d) Protista

20. Species that are in same ________ are more closely related than species that are in the same ___________.

(a) Phylum….Class
(b) Family…..Order
(c) Class…..Order
(d) Family….Genus

21. When a last member of a particular species dies, the species is said to be _______.

(a) Established (b) Extinct
(c) Threatened (d) Endangered

(Lahore board 2011 G I)

22. In which season Houbara bustard migrates to Pakistan and settles here?

(a) Summer (b) Spring
(c) Autumn (d) Winter

23. Who published important work on plants classification?

(a) John Ray
(b) Andrea Caesalpino
(c) Tourrnefort
(d) Agustus Rivinus

24. What is the greatest threat to biodiversity on this planet?

(a) Habitat loss (b) deforestation
(c) overpopulation (d) b and c

25. Who divided living organisms into three kingdom Classification System?

(a) Linnaeous (b) Aristotle
(c) John Ray (d) Hackel

26. How many children born in each minute in the world?

(a) 100 (b) 150
(c) 180 (d) 200

27. How many kinds of organisms inhabit the earth?

(a) 1 million (b) 5 million
(c) 10 million (d) 10 billion

28. Biodiversity means:

(a) Variety within a species
(b) Variety among the species
(c) Variety within a species and among the species

(d) None of these

29. The bio diversity of any region depends on:

(a) Climate

(b) Altitude

(c) Soil and other species

(d) All of these

30. Biodiversity is richer in:

(a) Tropics

(b) Temperate regions

(c) Polar regions

(d) Desert

31. Biodiversity is the source of:

(a) Food (b) Fibres

(c) Rubber and oil (d) All of these

32. The kinds of animals found on Earth:

(a) 0.5 million (b) 1.0 million

(c) 1.5 million (d) 2 million

33. The kinds of plants found on Earth:

(a) 0.1 million (b) 0.3 million

(c) 0.5 million (d) 1.0 million

34. The branch of biology which deals with classification is?

(a) Taxonomy (b) Systematic

(c) Botany (d) Genetics

35. On what basis, organisms have been classified by biologists?

(a) Similarities (b) differences

(c) both a and b (d) Randomly

36. It is a group of related phyla:

(a) Kingdom (b) Class

(c) Order (d) Family

37. It is a group of related classes:

(a) Phylum (b) Class

(c) Family (d) Species

38. It is a group of related orders:

(a) Genus (b) Family

(c) Species (d) Class

39. It is a group of related genera:

(a) Species (b) Family

(c) Order (d) Class

40. Which one is the lowest taxon of classification?

(a) Genus (b) Order

(c) Species (d) Phylum

41. The scientific name of human being is:

(a) *Homo sapiens*

(b) *Pisum sativum*

(c) *Amanita muscaria*

(d) *E. coli*

42. The class of man is:

(a) Insecta (b) Mammalia

(c) Magnoliopsida (d) Proteobacteria

43. The kingdom of bacteria is.

(a) Fungi (b) Monera

(c) Protista (d) Plantae

44. Who suggested the first system of classification of organisms?

(a) Al-Jahiz (b) Aristotle

(c) John Ray (d) Averroes

45. In which language, Ibn-Rushd translated the Aristotle's book "de Anima"?

(a) Ibrani (b) Arabic

(c) Hindi (d) Persian

46. Who introduced Taxon of 'order' in classification?

(a) Caesalpino (b) John Ray

(c) Tournefort (d) Rivinus

47. Modern classification (binomial nomenclature) is based on the work of:

(a) Caesalpino (b) John Ray

(c) Tournefort
(d) Carolous Linnaeus

48. Who proposed the kingdom protista?
(a) Ernst Hackel (b) Robert Whittaker
(c) Margulis (d) Schwartz

49. The terms "procariotique" and "eucariotique" were introduced by E. Chatton in:
(a) 1866 (b) 1937
(c) 1988 (d) 1990

50. Five kingdom classification system was first introduced by:
(a) Margulis (b) Hackel
(c) Whittaker (d) Linnaeus

51. All prokaryotic organisms are included in kingdom:
(a) Protista (b) Monera
(c) Fungi (d) Plantae

52. Which one is not related to protista?
(a) Algae (b) Protozoans
(c) Bacteria
(d) Fungi like organisms

53. Which kingdom includes eukaryotic, multicellular and absorptive heterotrophs?
(a) Monera (b) Protista
(c) Fungi (d) Plantae

54. Which of the following character is not related to Animalia?
(a) Eukaryotic (b) Multicellular
(c) Heterotrophs (d) Autotrophs

55. Which one of the following is without nuclear membrane?
(a) Animalia (b) Plantae
(c) Monera (d) Protista

56. Cellular organization is absent in:
(a) Viruses (b) Bacteria
(c) Algae (d) Protozoans

57. The body of which organism consists only of RNA?
(a) Prions (b) Viroids
(c) Viruses (d) Algae

58. The species which will become extinct in future:
(a) Threatened (b) Endangered
(c) Extinct (d) All of these

59. How many people live on earth today?
(a) 100 million (b) 300 million
(c) 400 million (d) 600 million

60. It is the national animal of Pakistan.
(a) Dolphin (b) Ibex
(c) Markhor (d) Camel

61. The large omnivorous bird that flies to Pakistan in winter from former Soviet territory is:
(a) Chakor (b) Houbara bustard
(c) Kiwi (d) Ostrich

62. Forests are the source of:
(a) Drugs (b) Fuel
(c) Timber (d) All of these

63. Deforestation results in.
(a) Soil erosions
(b) Increased water storage capacity of dams
(c) More humidity
(d) More clouds

64. The lowest taxon among the following is:
(a) Genera (b) Class
(c) Order (d) Families

65. Euglena is included in kingdom:
(a) Monera (b) Protista
(c) Fungi (d) Plantae

66. A species is a group of natural population which can:
(a) Interbreed and produce offsprings
(b) Interbreed in nature and produce offspring
(c) Interbreed and produce fertile offspring
(d) Interbreed in nature and produce fertile offsprings

67. The need of third kingdom protista raised due to:
(a) presence of certain unicellular organisms
(b) presence of plant like character
(c) presence of animal like characters
(d) presence of both animal and plant like characters

68. Fungi cannot be placed in plantae kingdom because:
(a) Fungi lack cell wall
(b) fungi lack root, stem and leave
(c) Fungi lack chlorophyll
(d) Fungi do not store food

69. Robert Whittaker selected which one of the following as principle for the formation of five kingdom classification system?
(a) Mode of locomotion
(b) Mode of nutrition
(c) Mode of reproduction
(d) Mode of respiration

70. The five kingdom classification system is not based on:
(a) Mode of nutrition (b) Cytology
(c) Genetics (d) Morphology

71. It is at the risk of becoming extinct because few members are left:
(a) Extinct (b) Threatened
(c) Vulnerable (d) Endangered

72. Marco polo Sheep is found in:
(a) Khunjerab National Park
(b) plains
(c) India
(d) Indus Valley

73. Members of the same species living in the same place is called:
(a) Habitat (b) Biosphere
(c) Community (d) Population
(Lahore board 2011 G I)

Answers

1.	d	**11.**	a	**21.**	b	**31.**	d	**41.**	a	**51.**	b	**61.**	B	**71.**	d
2.	a	**12.**	d	**22.**	d	**32.**	c	**42.**	b	**52.**	c	**62.**	D	**72.**	a
3.	b	**13.**	d	**23.**	a	**33.**	c	**43.**	b	**53.**	c	**63.**	A	**73.**	d
4.	a	**14.**	b	**24.**	a	**34.**	a	**44.**	b	**54.**	d	**64.**	A		
5.	d	**15.**	c	**25.**	d	**35.**	c	**45.**	b	**55.**	c	**65.**	B		
6.	b	**16.**	d	**26.**	c	**36.**	a	**46.**	d	**56.**	a	**66.**	D		
7.	d	**17.**	d	**27.**	c	**37.**	a	**47.**	d	**57.**	b	**67.**	D		

8.	c	18.	a	28.	c	38.	d	48.	a	58.	b	68.	C		
9.	d	19.	c	29.	d	39.	b	49.	b	59.	d	69.	B		
10.	b	20.	b	30.	a	40.	c	50.	c	60.	c	70.	D		

Short Questions

Q.1. What is term Acellular?

Ans. Non – cellular , a living entity without cells. e.g viroid , prion

Q.2. Define class Animalia.

Ans. It includes eukaryotic, multicellular, consumers. They lack cell wall and can do locomotion. e.g. humans, lion, cat etc.

Q.3. Define Binonial nomenclature. **(Lahore board 2012 G I)**

Ans. It is the method introduced by carolous Linnaeus (1707-1778).It is the method of giving scientific name to a species or living organism. The name of organism, consisting of two parts, first one is the genus name and second one is the name of species. e.g. The scientific name of human is *Homo sapiens*

Q.4. Define Class.

Ans. A class is a group of related orders,

Q.5. Define Classification.

Ans. The arrangement of organisms into groups and sub-groups on the basis of similarities and differences is called classification

Q.6. Define Conservation.

Ans. The protection, preservation, management or restoration of natural environment and the ecological communities that inhabit them.

Q.7. What are Endangered Species? **(Lahore board 2012 G II)**

Ans. A species is called endangered if it is at the risk of becoming extinct when few members of that species are left.

Q.8. Define Family

Ans. A family is a group of related genera.

Q.9. Define Fauna

Ans. The diversity in animals is called fauna.

Or

The study of total found animals in a particular region is known as fauna.

Q.10. Define Flora

Ans. The diversity in plants is called flora

Or

The study of total occuring plants in a particular region is known as flora.

Q.11. Define Fungi

Ans. A group of hetertrophic organisms with absorptive mode of nutrition is called fungi. Fungi cell wall is made up of chitin and are also called decomposers.

Q.12. Define Genus

Ans. A genus is a group of related species.

Q.13. What is IUCN?

Ans. International Union for the Conservation of Nature and Natural Resources.

Q.14. Define Monera.

Ans. It includes prokaryotic organisms. They lack definite membrane bounded nucleus and membrane bounded organelles.

Q.15. Define Order.

Ans. An orders is a group of related families.

Q.16. Define Phylum.

Ans. A phylum is a group of related classes.

Q.17. Define Plantae.

Ans. It includes eukaryotic multicellular autotrophs. They have multicellular sex organs Cell wall is made up of cellulose.

Q.18. Define Prion.

Ans. Prions are composed of protein only and act as infectious particles in plants. They are acellular particles.

Q.19. Define Protista.

Ans. It consists of the group of most diverse organisms. It consists of unicellular and simple multicellular eukaryotes. It includes animal like protogoans. Plant like algae and fungi like protists.

Q.20. What is Soil erosion?

Ans. The removal of top layer of soil by wind, rain or flood is called soil erosion.

Q.21. Define Systematics.

Ans. The branch of biology which deals with evolutionary histories of organisms is known as systematics.

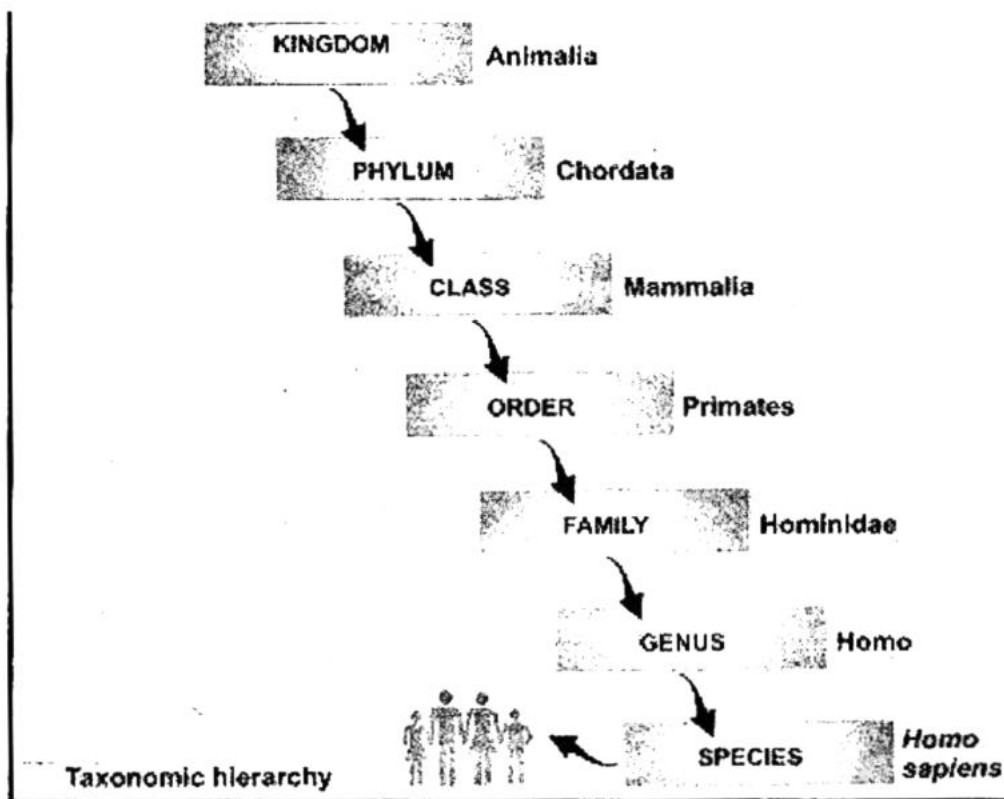
Q.22. Define Taxon.

Ans. The group into which living organisms are classified are called taxa (singular taxon)

Or

Each rank of classification is known as taxon. e.g. kingdom, phylum, class.

Q.23. Define Taxonomic hierarchy.

Ans. The groups into which organisms are classified are known as taxa and these taxa form a ladder called taxonomic hierarchy.

Q.24. Define the term Viroid.

Ans. Viroids are composed of circular RNA only and act as infectious particles and causes diseases in certain plants.

Q.25. What is the origin of biodiversity?

Ans. 10 million kinds of organisms inhabit the earth. But biologists studied and catalogued less than one third of these. Diversity among the organisms is more obvious than fundamental unity of life. This diversity emerged as modifications in organisms.

Q.26. Define biodiversity. Describe briefly the meaning of biodiversity. (Lahore Board 2011 G I)

Ans. Biodiversity is a measure of the variety of organisms present in different ecosystems. The term "biodiversity" is derived from "bio" and "diversity". Bio means life and "Diversity" means variety within a species and among species.

Q.27. Give importance of biodiversity.

Ans. 1- Biodiversity provides food for humans

2- Most of drugs are derived, directly or indirectly, from biological sources.

3- Many industrial materials are derived directly from biological resources. These materials are building materials, fibres, dyes, resins, gums, adhesives, rubber and oil.

Q.28. Define taxonomy and systematics?

Ans. The branch of biology which deals with classification is called taxonomy. The branch which deals with classification and traces the evolutionary history of organisms is called systematics.

Q.29. Define Species.

Ans. A species is a group of organisms which can interbreed freely among them and produce fertile offspring, but are reproductively isolated from all other such groups in nature.

Q.30. Is the interbreeding concept of species is applicable to organism which reproduce asexually?

Ans. The criteria of interbreeding is applied to those which regularly interbreed among themselves. But in some groups asexual reproduction predominates. Therefore they do not interbreed with one another. Thus here interbreeding cannot be used as a criterion for species recognition.

Q.31. What is the role of Ibn Rushd (Averroes) in classification?

Ans. He was a judge (Qazi) in Seville (Spain). In 1172, he translated and abridged Aristotle's book "de Anima (On the Soul)" into Arabic. His original commentary has now lost. But its translation into Latin is available.

Q.32. What were the objections on three kingdom system?

Ans. 1- This system did not clear the difference between prokaryotes and eukaryotes.

2- Some biologists disagreed about the position of fungi in kingdom plantae. Fungi resemble plants in many ways. But they are not autotrophs. They are special form of heterotrophs. They get their food by absorption. They do not have cellulose in their cell walls. Their cell wall is composed of chitin.

Q.33.What was the work of Robert Whittaker? Give his basis of classification?

Ans. In 1967, he introduced the five-kingdom classification system. This system is based on **1- the levels of cellular organization** i.e. prokaryotic, unicellular eukaryouic and multicellular eukaryotic. **2- The principal modes of nutrition** i.e. photosynthesis, absorption, and ingestion.

Q.34. When does scientific name is abbreviated? Give example.

Ans. The scientific name is generally written in full when it is first used. But sometimes several species form the same genus. Here they may be abbreviated by just using an initial for the genus. For example, the bacterium *Escherichia coli* is often written as just *E. coli*.

Q.35. What are the benefits of using binomial nomenclature?

Ans. 1- This system has great value. It has widespread use.

2- There is stability of its names. Every species can be unambiguously identified by binomial nomenclature.

3- It requires just two words. 4- The same name can be used all over the world, in all languages. It avoids difficulties of translation.

Q.36. How biodiversity is lost by over-hunting.

Ans. Over-hunting is also an important cause of the extinction of species. It is causing endangerment of many species like whales, ibex, urial, markhor etc. (Markhor is the national

animal of Pakistan). There is legal and illegal commercial hunting. It is the principal threat to biodiversity i.e. 23%

Q.37. What is deforestation?

Ans. The cutting down of trees for the conversion of a forest to non-forest land is called deforestation. It is done for using the land for various purposes. Humans use this land for pasture or urban use etc.

Q.38. What is Northern Areas Conservation Project?

Ans. The northern areas of Pakistan is a habitat for a number of wildlife species. The survival of these species is under threat. The NACP is a project of WWF-P. It is successful in implementing a ban on the hunting of these species.

Q.39. What is Conservation of migratory birds in Chitral, NWFP?

Ans. Chitral lies on the migratory route of several important bird species. These birds face enormous hunting pressure. WWF-Pakistan initiated efforts to reduce the hunting pressure in 1992. These efforts proved successful.

Q.40. What are the reasons of decline of Houbara bustard?

Ans. It is hunted by the foreigners. This bird is popular among the Arabs. Its population is not declined only due to hunting. It is also declined due to the destruction of its natural habitats.

Q.41. What factors do affect biodiversity of a region?

Ans. i) Climate ii) Altitude iii) Soil iv) Presence of other species.

Q.42. Why Carolus Linnaeus is famous?

Ans. i) He introduced Binomial nomenclature.

ii) He divided the nature into three kingdoms: (i) Minerals (ii) vegetables (iii) animals.

iii) He used five ranks for classification: (i)class (ii)order (iii)genus (iv)species (v)variety.

Q.43. What are the aims of classification?

Ans. i) To determine similarities and differences among organisms so that they can be recognized and studied easily.

ii) To find the evolutionary relationship among organisms.

Q.44. What is basis of classification?

Ans. Classification is based on similarities in the form or structure. These similarities are seen in:

i. Structure (Both external and internal) ii. Stage of development

iii. Modern genetics

These similarities suggest that all organisms are related to one other at some point in their evolutionary histories.

However, some organisms are closely related than others, for example sparrows are more closely related to pigeons than to insects. It means sparrows and pigeons have common evolutionary histories. The differences are also considered as the basis of classification.

Q.45. What are Taxa? Give examples.

Ans. The groups into which organisms are classified are called taxa. e.g. Kingdom, phylum, class, order, family, genus, species.

Q.46. Name the largest and smallest taxa?

Ans. Kingdom is the largest taxon while species is the smallest taxon.

Q.47. Write the names of five kingdoms of organisms.

Ans. i) Monera

ii) Protista

iii) Plantae

iv) Fungi

v) Animalia

Q.48. What are the characteristics of kingdom Monera?

i) It includes prokaryotes.

ii) They are mostly unicellular, although some types form chains, clusters or colonies of cells.

iii) They are mostly heterotrophic but few are photosynthetic e.ge., Bacteria, cyanobacteria.

Q.49. What are the types of protista?

Ans. i) Protozoans (Animal like protists)

ii) Algae (plant like protists)

iii) Fungi like protists

Q.50. What are simple multicellular organisms?

Ans. They don't have multicultural sex organs and don't form embryos during their life cycles. e.g., algae and fungi like protists

Q.51. Give examples of Protozoans

Ans. i) Paramecium

ii) Amoeba

iii) Volvox

Q.52. How can you divide the five kingdoms into two groups on the basis of types of cells?

Ans. Group – I: Monera includes organisms with Prokaryotic cells.

Group – II: Protista, Plantae, Fungi and Animalia include organisms with eukaryotic cells.

Q.53. Write the botanical names of piyaz and House crow.

Ans. Piyaz ⟶ *Allium cepa*

House crow *Corvus splendens*

Q.54. What is an extinct species?

Ans. A species is called extinct when there is no doubt that last individual of that species has died.

Q.55. Give a list of extinct animals in Pakistan.

Ans. **i)** Lion

ii) Asiatic Cheeta

iii) Tiger

iv) Indian one-horned Rhinoceros

v) Swamp deer

vi) Indian wild ass

vii) Hangul

viii) Black Buck

Q.56. What are the effects of deforestation?

Ans. i) Amount of water in soil and atmosphere is affected.

ii) Chances of soil erosion are increased.

iii) Storage capacity of dams is decreased.

iv) Amount of rainfall is decreased.

v) Amount of CO_2 is increased in atmosphere.

Q.57. Give significance of forests.

Ans. i) Forests support biodiversity. ii) Forests provide habitat for wildlife.

iii) Forests are the source of medicines, timber, fuel wood etc.

Q.58. Name the two organization working for conservation of biodiversity in Pakistan.

Ans. i) The international Union for the Conservation of Nature and Natural Resource (IUCN)

ii) The World Wildlife Fund – Pakistan (WWF-P)

Unit 04

CELLS AND TISSUES

Q.1. Define Microscopy. What do you know about first microscope?

Ans. Microscopy:

The use of microscope is known as microscopy.

First microscope:

The very first microscope was developed by Zacharias Janssen, in Holland in 1595. It was simply a tube with lenses at both ends and its magnification ranged from 3X to 9X.

Q.2. Explain important terms, which are used in microscopy.

Ans. Terms related to microscopy

Two important terms are used in microscopy:

(i) Magnification:

Magnification is the increase in the apparent size of an object and it is an important factor in microscopy.

(ii) Resolving power or resolution:

Resolving power or resolution is the measure of the clarity of an image. It is the minimum distance at which two objects can be seen as separate objects.

Resolution of human eye:

The human naked eye can differentiate between two points, which are at least 0.1mm apart. This is known as the resolution of human eye. Magnification and the resolution of human eyes can be increased with the help of lenses.

Q.3. Describe types of microscopes.

Ans. Two important types of microscopes used in microscopy are Light Microscope and Electron Microscope.

Light Microscope:

Introduction:

A light microscope works by passing visible light through a specimen.

Explanation

(i) Glass Lenses

It uses two glass lenses. One lens produces an enlarged image of the specimen and the second lens magnifies the image and projects it into the viewer's eye or onto photographic film. **(ii) Magnification**

Its magnification is 1500x

(iii) Micrograph

A photograph taken through a microscope is called a micrograph.

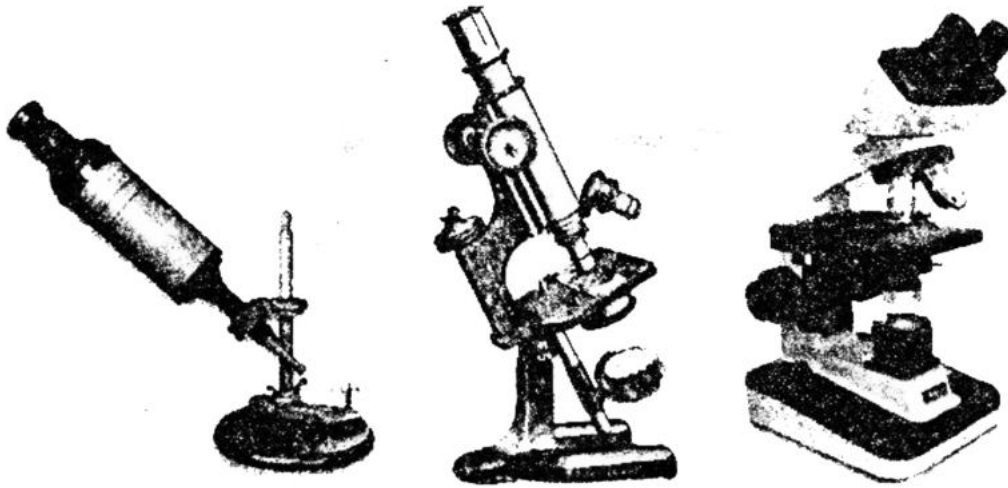



Figure 4.1: Light microscopes: From earlier (left) to the latest (right)

(iv) Resolving Power

Its resolving power is 0.2 micrometer (μm) and $1\mu m = \frac{1}{1000}$ mm. In other words, LM cannot resolve (distinguish) objects smaller than 0.2μm.

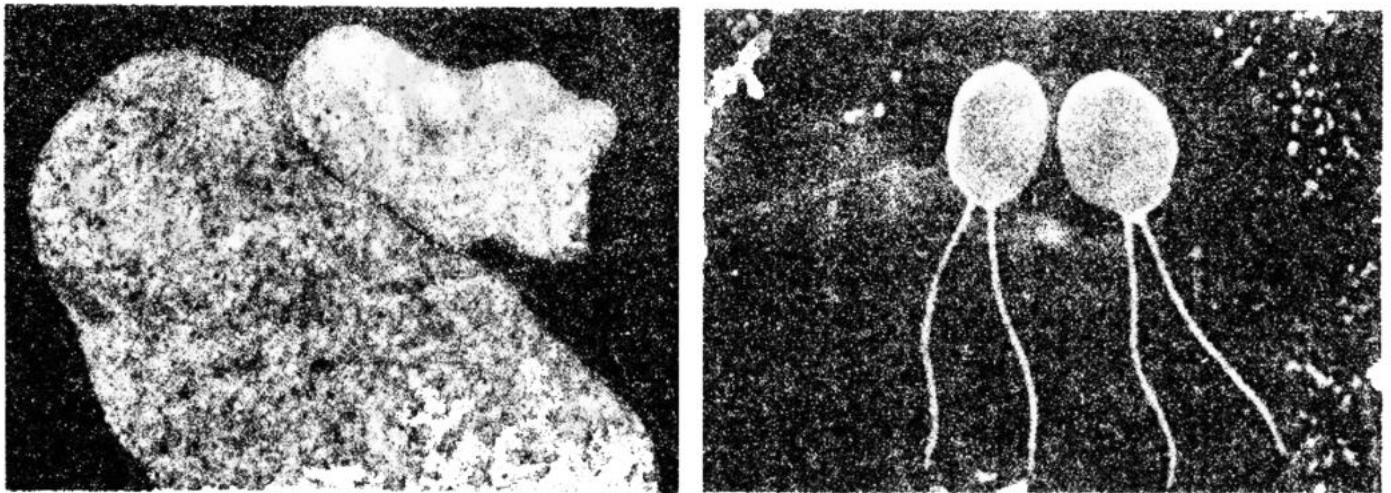



Figure 4.2: Light microscopic view; amoebae (left), unicellular algae (right)

Electron Microscope

Introduction

It is the most advanced form of microscope.

Explanation

(i) Working

In EM, object and lens are placed in a vacuum chamber and a beam of electrons is passed through object. Electrons pass through or are reflected from object and make image. Electro-magnetic lenses enlarge and focus the image into a screen or photographic film.

(ii) Resolving Power

The E.M has much higher resolving power than the LM. The most modern EM can distinguish objects as small as 0.2nanometer (nm) and $1nm = \frac{1}{1000,000} mm$.

(iii) Magnification

E.M can magnify objects about 250000 times.

(iv) Capability

EM can detect individual atoms, Cells, organelles and even molecules like DNA and proteins which are much larger than single atoms.

(iv) Types of Electron Microscopes

There are two types of electron microscopes.

(a) Transmission Electron Microscope (TEM)

(Lahore board 2011 G I)

In TEM, electrons are transmitted through specimen.

(i) Introduction

TEM is used to study the details of the internal cell structure.

Figure 4.3: The TEM view of an animal cell

(b) Scanning Electron Microscope (SEM)

In SEM, electrons are reflected from the metal coated surfaces.

(i) Introduction:

SEM is used to study the structure of cell surfaces.

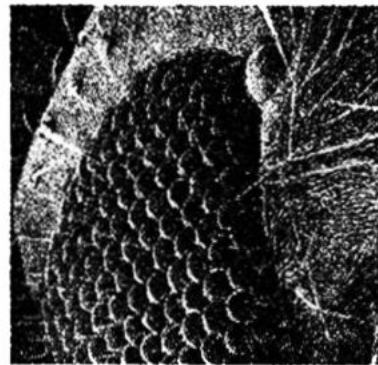
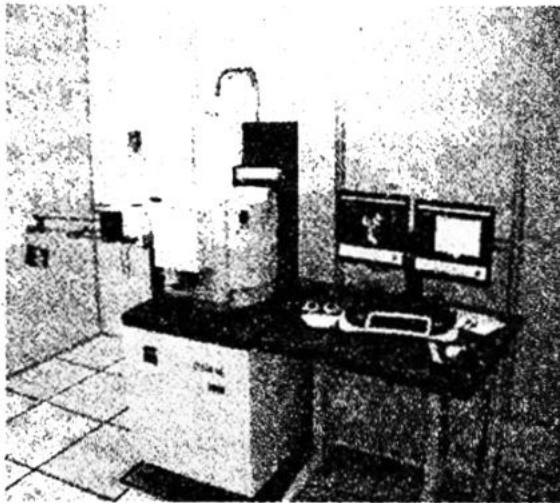



Figure 4.4: SEM (left) and view of mosquito's head and eye (right) through it

Q.4. Describe the history of the formulation of cell theory.

Ans. Greeks were the first who organized the data of natural world.

Aristotle

Aristotle presented the idea that all animals and plants are some how related.

Fundamental Unit – A Cell

But before microscopes were first used in 17^{th} century, no one knew with certainty that living organisms do share a fundamental unit i.e. cell.

Robert Hooke

Cells were first described by a British scientist Robert Hooke in 1665. He used his self made light microscope to examine a thin slice of cork. Hooke observed a "honey comb" of tiny empty compartments. He called the compartments in the cork as "cellulae". His term has come to us as cells.

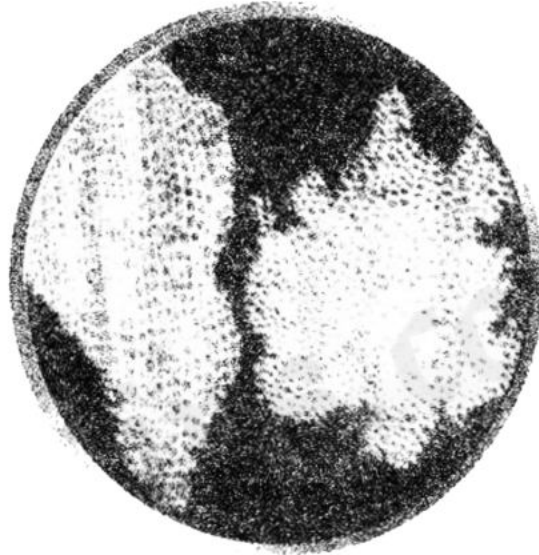



Figure 4.5: Robert Hooke was a chemist, mathematician and physicist. His remarkable engineering abilities enabled him to invent and improve many Mechanical devices including time pieces, the quadrant and the Gregorian telescope. His observation about the section of cork is also illustrated here.

Antonie Van Leeuwenhoek

The first living cells were observed a few years later by Dutch naturalist Antonie Van Leeuwenhoek. He observed tiny organisms (from pond water) under his microscope and called them as "animalcules".

Jeans Baptist de-Lamarck

In 1809, Jeans Baptist de-Lamarck proposed that "no body can have life if its parts are not cellular tissues or are not formed by cellular tissues."

Robert Brown

In 1831, a British botanist Robert Brown discovered nucleus in the cell.

Schleiden and Schwann

In 1838, a German botanist Mathias Schleiden studied plant tissues and made the first statement of cell theory. He stated that all plants are aggregates of individual cells which are fully independent.

One year later, in 1839, a German zoologist Theodor Schwann reported that all animal tissues are also composed of individual cells.

Rudolf Virchow and Louis Pasteur

In 1855, Rudolf Virchow, a German physician, proposed an important extension of cell theory. He proposed that all living cells arise from pre-existing cells ("omnis cellula e cellula").

Louis Pasteur

In 1862, Loius Pasteur provided the experimental proof of this idea.

Salient features of Cell Theory

Cell theory was presented by Schleiden & Schwann. Cell Theory in its modern form, includes following principles;

(i) All organisms are composed of one or more cells.
(ii) Cells are the smallest living things, the basic unit of organization of all organisms.
(iii) Cells arise only by divisions in previously existing cells.

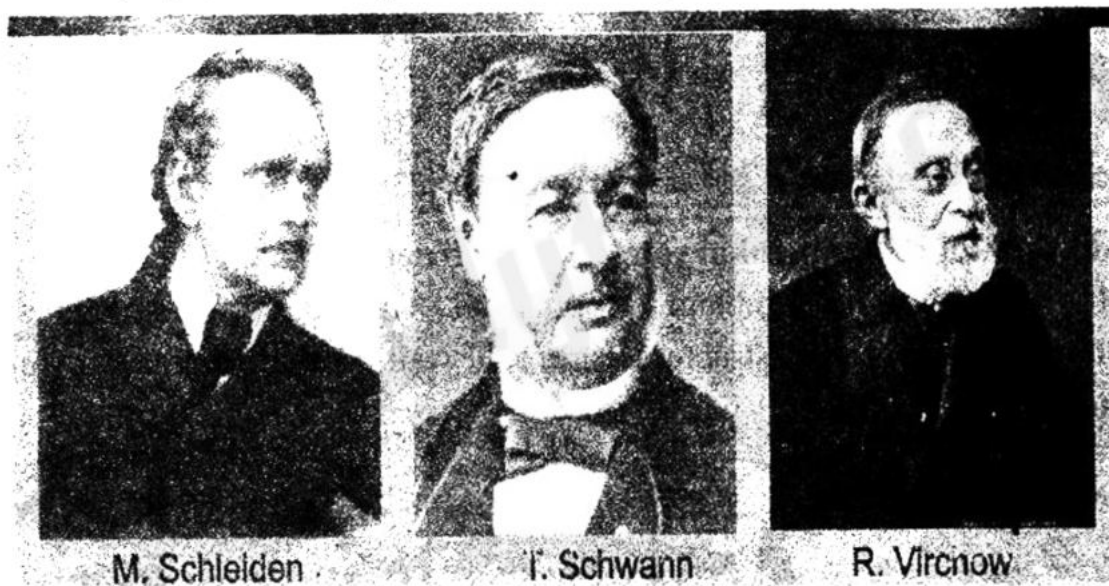
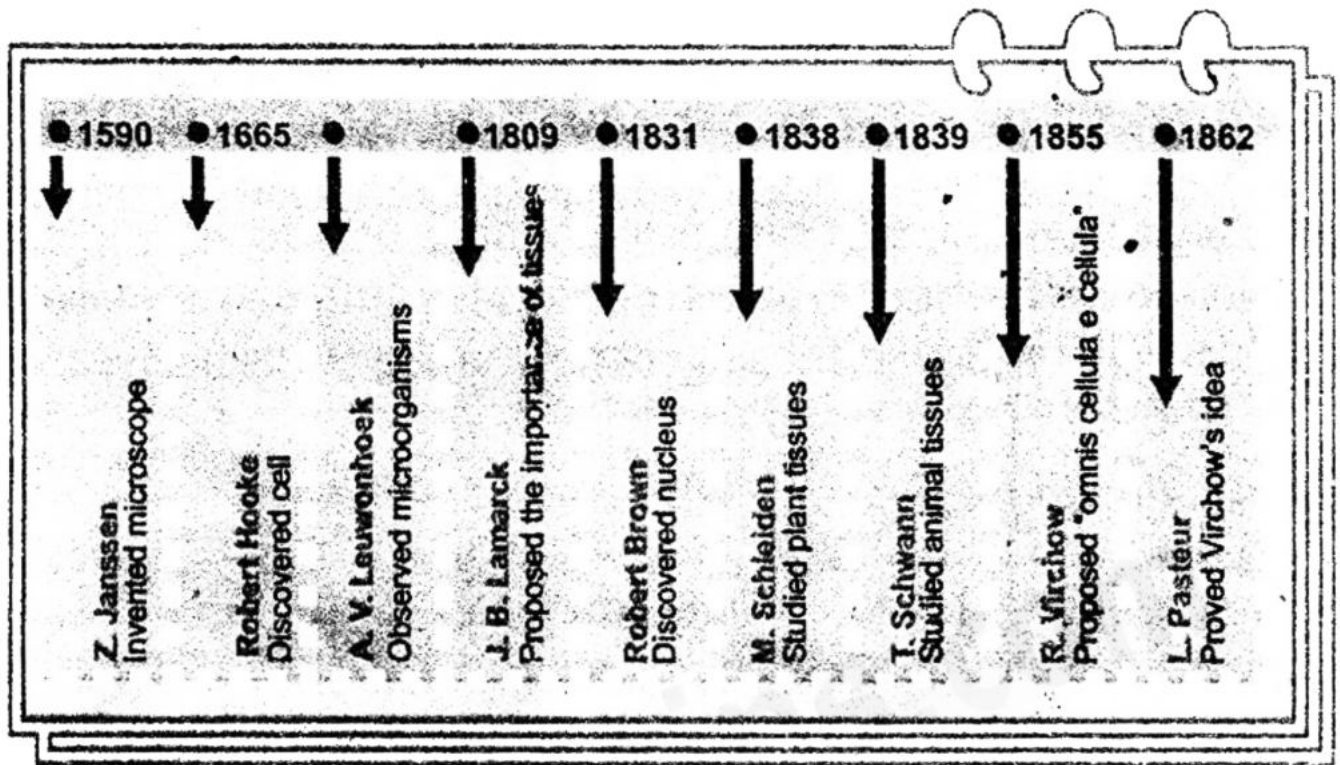



Figure 4.6: Three great German biologists

Q.5. What do you know about sub-cellular particles or a-cellular particles?

Ans. Viruses, prions and viroids are not composed of cells; rather they are sub-cellular particles or acellular particles which do not run any metabolism inside them. But they show some characteristics of living organisms i.e. they can increase in number and can transmit their characters to the next generations. These are not classified in any of the five kingdoms of organisms.

Q.6. Construct a time line that traces the history of formulation of the cell theory.

Ans.

Q.7. What do you know about eukaryote cellular structures?

Ans. A cell is made by the assemblage of organelles. There are some structures in the cell that are not organelles. These structures are cell wall, cell membrane, cytoplasm and cytoskeleton.

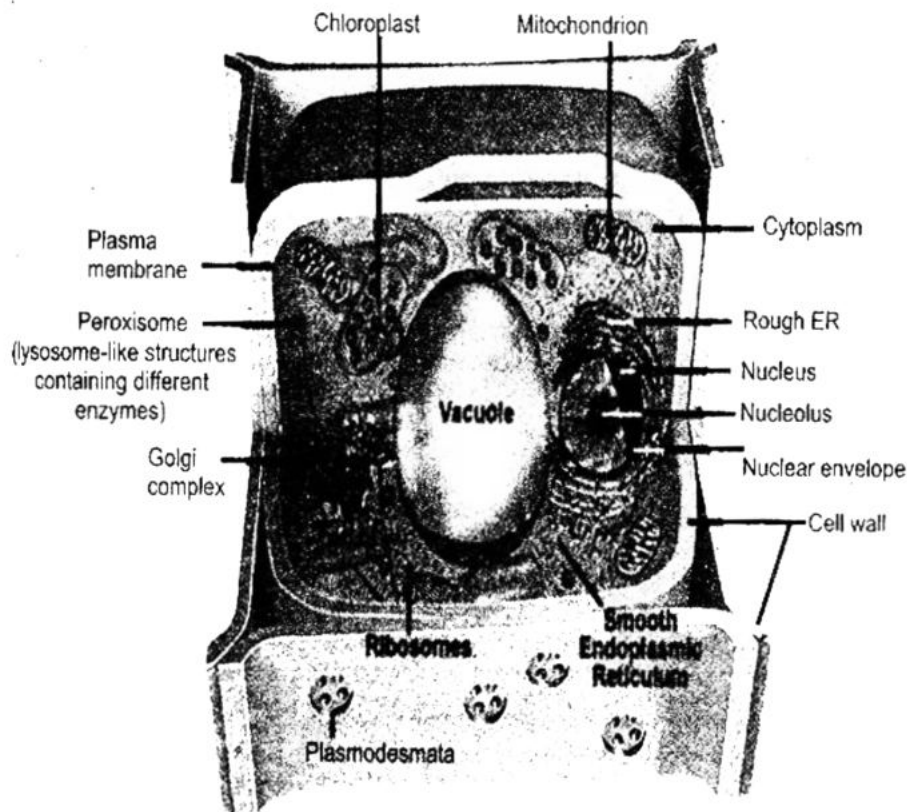
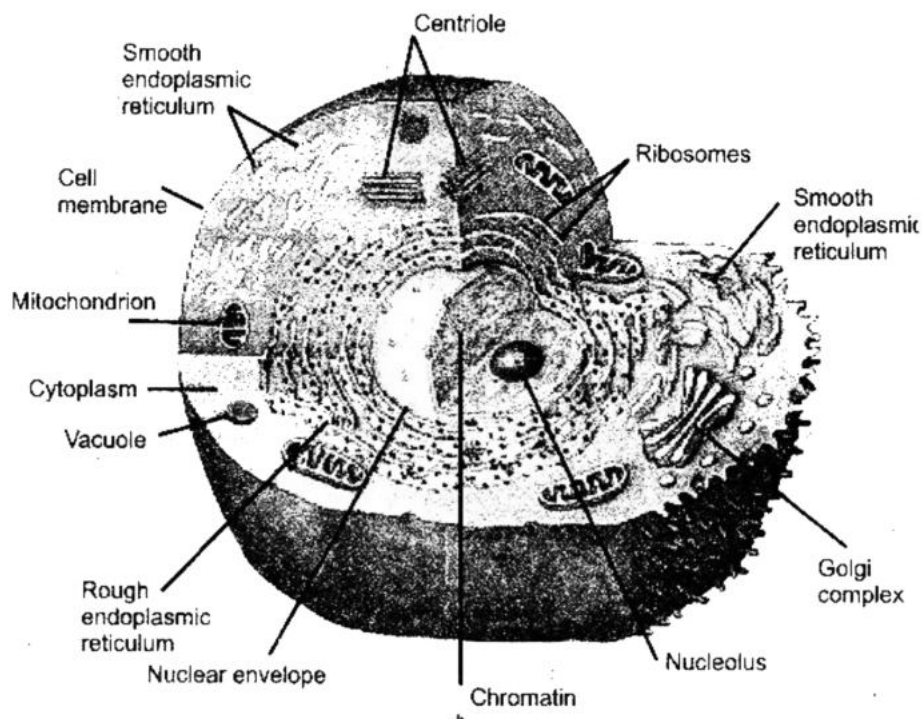



Figure 4.8: The ultra- structure of an animal cell

Q.8. Write a note on cell wall.

Ans. Cell Wall

Introduction

The cell wall is a non-living strong component of the cell and it is located outside the plasma membrane. Not all living organisms have cell walls around their cells e.g., animals and many animal like protists.

Function

It provides shape, strength, protection and support to the inner living matter (protoplasm) of the cell.

Chemical composition

Plant cells have a variety of chemicals incorporated in their cell walls.

Types

Primary wall **(Lahore board 2012 G II)**

The outer layer of the plant cell wall is known as primary wall and the cellulose is the most common chemical in it.

Secondary Wall **(Lahore board 2012 G II)**

Some plant cells, for example xylem cells also have secondary walls on the inner side of the primary wall. It is much thicker and contains lignin and some other chemicals.

Plasmodesmata

There are pores in the cell walls of adjacent cells, through which their cytoplasm is connected. These pores are called plasmodesmata.

Cell wall of fungi

Fungi and many other protists have cell walls although they do not contain cellulose. Their cell walls are made of variety of chemicals. For example, chitin is present in the cell wall of fungi.

Cell wall of prokaryotes

Prokaryotes have a cell wall composed of peptidoglycan that is a complex of amino acids and sugar.

Q.9. Write a note on cell membrane.

Ans. Cell Membrane

All prokaryotic and eukaryotic cells have a thin and elastic cell membrane covering the cytoplasm.

Function

Cell membrane functions as a semi permeable barrier, allowing a very few molecules across it while fencing the majority of chemicals inside the cell. In this way, the membrane maintains the internal composition of cell. In addition to this vital role, cell membrane can also sense chemical messages and can identify other cells etc.

Figure 4.9: The fluid- mosaic model of cell membrane

Chemical composition

Chemical analysis reveals that cell membrane is mainly composed of proteins and lipids with small quantities of carbohydrates. Electron microscopic examinations of cell membranes have led to the development of the fluid mosaic model of cell membrane.

Fluid mosaic model

According to this model:

(i) Lipids

There is a Lipid bilayer in which the protein molecules are embedded. The lipid bilayer gives fluidity and elasticity to membrane.

(ii) Carbohydrates

Small amounts of carbohydrates are also found in cell membranes. These are joined with proteins or lipids of membrane.

(iii) Cholesterol

In eukaryotic cells, cholesterol is also present in lipid bilayer.

Eukaryotic cell

In eukaryotic cell, many organelles e.g. mitochondria, chloroplasts, golgi apparatus and endoplasmic reticulum are also bounded by cell membrane.

Q.10. Write a note on cytoplasm.

Ans. Cytoplasm

Definition

Cytoplasm is defined as the material between the plasma membrane (cell membrane) and the nuclear envelope. It is a semi-viscous and semi-transparent substance.

Chemical composition

The chemical analysis of cytoplasm reveals that it contains water which consists of;

(i) Organic molecules

Such as proteins, carbohydrates and lipids.

(ii) Inorganic salts

Inorganic salts are completely or partially dissolved.

Functions

The cytoplasm of the cell provides space for the proper functioning of the organelles and also acts as the site for various biochemical (metabolic) reactions. For example, Glycolysis (breakdown of glucose during cellular respiration) occurs in cytoplasm.

Q.11. Write a note on cytoskeleton.

Ans. Cytoskeleton

Structure

Cytoskeleton is a network of microfilaments and microtubules.

Figure 4.10: Cytoskeleton

Microtubules

Microtubules are made of tubulin protein and are used by cells to hold their shape. Microtubules are also major components of cilia and flagella.

Microfilaments

Microfilaments are made of actin protein. They help cells to change their shapes.

Q.12. Write a note on Nucleus. **(Lahore board 2011 G II)**

Ans. Nucleus

A prominent nucleus is present in eukaryotic cells.

Location (Lahore board 2012 G II)

In animal cells, it is present in the centre while in mature plant cells, due to the formation of large central vacuole, it is pushed to a side.

Nuclear membrane

The nucleus is bounded by a double membrane known as nuclear envelope. Nuclear envelope contains many small pores that enable it to act as a semi-permeable membrane.

Nucleoplasm

Inside the nuclear envelope, a granular fluid, i.e., the nucleoplasm is present. Nucleoplasm contains one or two nuecleoli (singular: nucleolus) and chromosomes.

Nucleolus

The nucleolus is a dark spot and it is the site where ribosomal RNA is formed and assembled as ribosomes.

Chromosomes

Chromosomes are only visible during cell division while during interphase (non-dividing phase) of the cell they are in the form of fine thread like structures known as chromatin. Chromosomes are composed of Deoxyribonucleic acid (DNA) and proteins.

Figure 4.11: Structure of Nucleus

Nucleus of Prokaryotic cell

The prokaryotic cells do not contain prominent nucleus. Their chromosomes is made up of DNA only and is submerged in the cytoplasm.

Location (Lahore board 2012 G II)

In animal cells, it is present in the centre while in mature plant cells, due to the formation of large central vacuole, it is pushed to a side.

Nuclear membrane

The nucleus is bounded by a double membrane known as nuclear envelope. Nuclear envelope contains many small pores that enable it to act as a semi-permeable membrane.

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Figure 4.11: Structure of Nucleus

Nucleus of Prokaryotic cell

The prokaryotic cells do not contain prominent nucleus. Their chromosomes is made up of DNA only and is submerged in the cytoplasm.

(ii) Chromoplasts

(iii)Leucoplast

Chloroplasts

Structure

Chloroplast is also bounded by double membrane. The outer membrane is smooth while the inner one gives rise to sacs called thylakoids. The stack of thylakoids is known as granum [plural grana] floating in the inner fluid of chloroplast i.e. the stroma.

Granum
Thylakoid
Inner membrane
Outer membrane
Stroma

Figure 4.14: Structure of the chloroplast

Function

Chloroplasts are the sites of photosynthesis in eukaryotes. They contain chlorophyll, the green pigment necessary for the photosynthesis and associated accessory pigments. These pigments are present in the thylakoids of the grana.

Chromoplasts

Introduction

The second type of plastids in plant cells are chromoplasts. They contain pigments associated with the bright colours and are present in the cells of flower petals and fruits.

Function

Their function is to give colours other than green to these parts and thus help in pollination and dispersal of fruit.

Leucoplasts

Introduction

Leucoplasts are the third type of plastids. They are colourless and store starch, proteins and lipids.

Functions

They are present in the cells of those parts where food is stored.

Q.16. Write a note on endoplasmic reticulum.

Ans. Endoplasmic Reticulum

Endoplasmic reticulum is a network of interconnected channels that extend from cell membrane to the nuclear envelope. This network exists in two forms.

Figure 4.15: Smooth and Rough Endoplasmic Reticulum

(i) Rough Endoplasmic Reticulum (RER)

(RER) is so named because of its rough appearance due to the numerous ribosomes that are attached to it. Due to the presence of ribosomes, RER serves a function in protein synthesis.

(ii) Smooth Endoplasmic Reticulum (SER)

(SER) lacks ribosomes and is involved in lipid metabolism and in the transport of materials from one part of the cell to the other. It also detoxifies harmful chemicals that have entered the cell.

Q.17. Write a note on Golgi Apparatus.

Ans. Golgi Apparatus

Definition

An Italian physician Camillo Golgi discovered a set of flattened sacs (cisternae) in cell. In this set, many cisternae are stacked over each other. The complete set of cisternae is called Golgi apparatus or Golgi complex.

Occurrence

It is found in both plant and animal cells.

Function

It modifies molecules coming from rough ER and packs them into small membrane bound sacs called Golgi vesicles. These sacs can be transported to various locations in the cell or to its exterior in the form of secretions.

In 1906, Golgi was awarded Nobel Prize for physiology and medicine.

Figure 4.16: Camillo Golgi

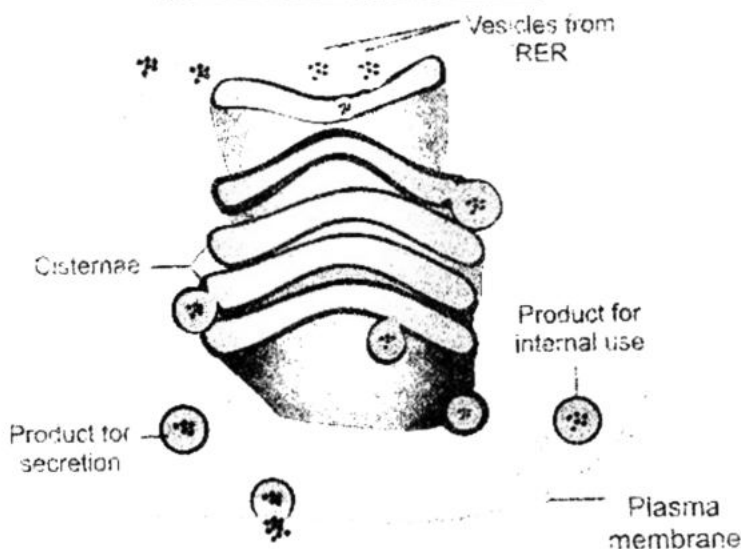



Figure 4.17: Functioning of the Golgi apparatus

Q.18. Write a note on Lysosomes.

Ans. Lysosomes

Introduction These are single membrane bounded organelles.

Discovery In the mid twentieth century, the Belgian scientist Christian Rene de Duve discovered lysosomes.

Function

Lysosomes contain strong digestive enzymes and work for the break down (digestion) of food and waste materials within the cell. During its function, a lysosome fuses with the vacuole that contains the targeted material and its enzymes break down the material.

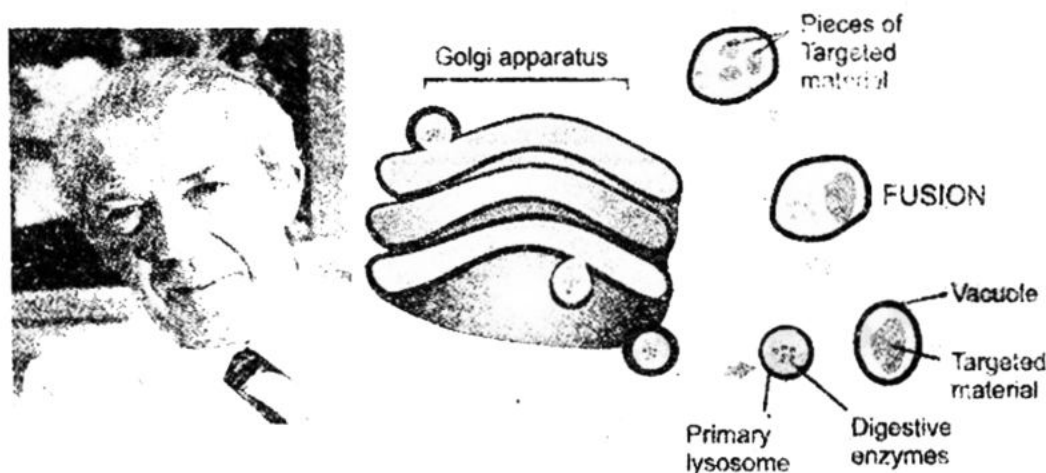



Figure 4.18: De Duve; Formation and Function of lysosome

Q.19. Write a note on Centriole.

Ans. Centriole

Definition: Animals and many unicellular organisms have hollow and cylindrical organelles known as centrioles.

Structure: Each centriole is made of nine triplets of microtubules made up of tubulin protein.

Location: Animal cells have two centrioles located near the exterior surface of the nucleus.

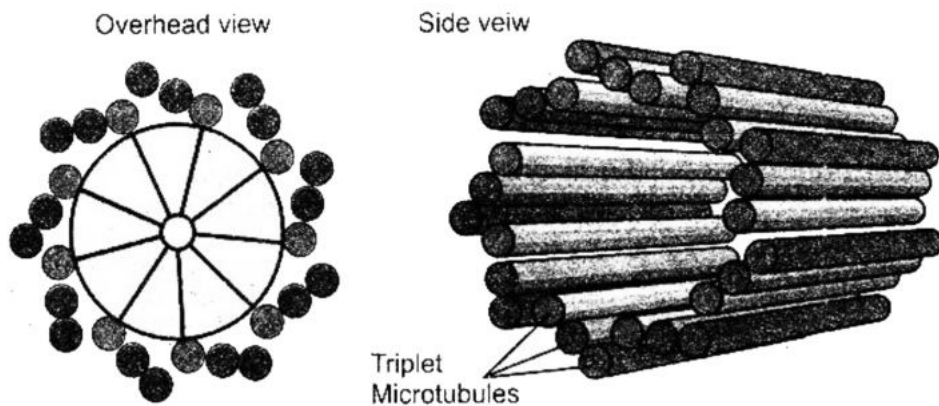



Figure 4.19: Structure of centriole

Centrosome: Two centrioles are collectively called a centrosome.

Function: Their function is to help in the formation of spindle fibres during cell division. In some cells, centrioles are involved in the formation of cilia and flagella.

Q.20. Write a note on vacuoles.

Ans. Vacoules

Definition

Vacoules are fluid filled single membrane bounded organelles.

Occurrence

Cells have many small vacuoles in their cytoplasm.

Function

When plant cells mature, its small vacuoles absorb water and fuse to form a single large vacuole in the centre. Fluid in this vacuole is called sap solution. Cells in this state become turgid. Many cells take in materials from outside in the form of food vacuole and then digest the material with the help of lysosomes.

Contractile Vacoule

Some unicellular organisms use contractile vacuole for the eliminations of wastes from their bodies.

Q.21. Describe the differences between prokaryotic and eukaryotic cells.

(Lahore board 2011 & 2012 G II)

Ans. Introduction

Prokaryotes possess prokaryotic cells which are much simpler than the eukaryotic cells.

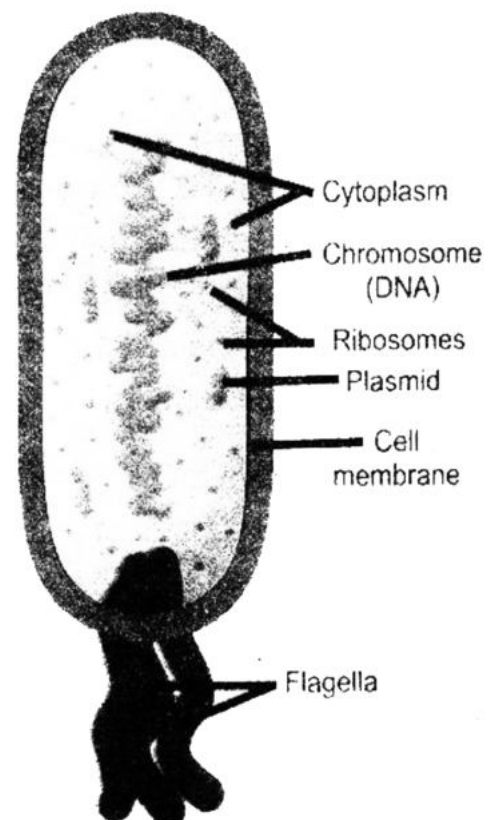



Figure 4.20: Structure of a generalized prokaryotic cell

Differences

(i) Prominent nucleus

Eukaryotic cells have prominent nucleus bounded by nuclear envelope while prokaryotic cells do not have prominent nucleus. Their chromosome consists of DNA only and it floats in cytoplasm near centre. This region is called nucleoid.

(ii) Membrane Bounded Organelles

Eukaryotic cells have membrane bounded organelles like mitochondria, golgi apparatus, endoplasmic reticulum etc. while such membrane bounded organelles are not present in prokaryotic cells.

(iii) Ribosomes

The ribosomes of eukaryotic cells are larger in size as compared to the ribosomes of prokaryotic cells.

(iv) Size

Eukaryotic cells are ten times larger than prokaryotic cells.

(v) Cell Wall

All prokaryotic cells have cell wall which is made of peptidoglycan (a large polymer of amino acids and sugar). The cell wall of eukaryotic cells is made of cellulose in plants or chitin in fungi.

Q.22. Describe the relationship between cell function and cell structure. **(Lahore board 2011 G I)**

Ans. Relationship between cell function and cell structure

The bodies of animals and plants are made up of different cell types. Human body is made of about 200 types of cells. Each type performs specific function and all coordinated functions become the life processes of the organisms. Cells of one type may differ from those of other types in following respects.

Size and Shape:	Red blood cells are round to accomodate globular haemoglobin.
	Nerve cells are long for the transmission of nerve impulse.
	Xylem cells are tube-like and have thick walls for conduction of water and support.
Surface area to volume ratio:	Root hair cells have large surface area for the maximum absorption of water and salts.
Presence or absence of organelles:	Cells involved in making secretions have more complex ER and Golgi apparatus.
	Cells involved in photosynthesis have chloroplasts.

Roles of Different Cells in Body

(i) Nerve Cells

Nerve cells conduct nerve impulse and thus contribute in coordination in body.

(ii) Muscle Cells

Muscle cells under go contraction and share their role in movements in body.

(iii) Red blood cells and white blood cells

Red blood cells carry oxygen and white blood cells kill foreign agents and so contribute in transportation and defence.

(iv) Skin Cells Some skin cells act as physical barriers against foreign materials and some as receptors for temperature, touch, pain etc.

(v) Bone Cells The cells of bone deposit calcium in their extracellular spaces to make the bone tough and thus contribute to the supporting role of the bones.

A cell works as an open system

Cells takes in substances needed for its metabolic activities through its cell membrane. Then it performs metabolic processes assigned to it. Products and by products are formed in metabolism. Cell either utilizes the products or transports them to other cells. The by-products are either stored or are excreted out of cell.

Q.23. Describe the relationship between cell size, shape and surface area to volume ratio.

Ans. Relationship between cell size and shape

Cells vary greatly in size.

Smallest Cells

The smallest cells are bacteria called Mycoplasmas with diameter between 0.1μm to 1.0μm.

Bulkiest Cells

The bulkiest cells are bird eggs.

Longest Cells

Longest cells are some muscle cells and nerve cells. Most cells lie between these extremes.

Relation of cell size and shape to cell function

Birds Egg

Bird's eggs are bulky because they contain a large amount of nutrient for the developing young.

Muscle Cells

Long muscle cells are efficient in pulling different body parts together.

Nerve Cells

Lengthy nerve cells can transmit messages between different parts of body.

Benefits of small cell size

Small cell size also has many benefits. For example human red blood cells are only 8μm in diameter and therefore can move through our tiniest blood vessels i.e. capillaries.

Surface area of large and small cells

Large cells have less surface area in relation to their volume while small cells of the same shape have more surface area. The figure shows relationship using cube shaped cells. The figure shows one large cell and 27 small cells. In both cases the total volume is the same:

Volume = $30\mu m \times 30\mu m \times 30\mu m = 27000\mu m^3$

Contrast or Comparison of total volume to total surface area

In contrast to the total volume, the total surface area are very different because the cubical shape has 6 sides. Its surface area is 6 times the area of 1 side. The surface areas of the cubes are as follows.

Surface area of 1 large cube = $6 \times (30\mu m \times 30\mu m) = 5400\mu m^2$

Surface area of 1 small cube = $6 \times (10\mu m \times 10\mu m) = 600\mu m^2$

Surface area of 27 small cubes = $27 \times 600\mu m^2 = 16200\mu m^2$

Figure 4.21: Effect of cell size on surface area

Role of Surface Area

The need of nutrients and rate of waste production are directly proportional to cell volume. The cell takes up nutrients and excretes wastes through its surface cell membrane. So a large volume cell demands large surface area. A large cell has much smaller surface area relative to its volume than smaller cells have. Hence it is concluded that the cell membrane of small cells can serve their small volumes more easily than the membrane of the large cell.

Q.24. Describe passage of molecules into and out of cells.

Ans. Introduction

Cell membrane acts as barrier to most molecules and is called semi-permeable membranes. Cell membranes maintain equilibrium inside and outside of cell by exchanging matter with cells and environment by following ways:

(i) Diffusion

Definition: Diffusion is the net movement of a substance from an area of higher concentration to area of lower concentration i.e. along a concentration gradient.

Explanation

1- Since the molecules of any substance (solid, liquid or gas) are in motion, when that substance is above 0 degree Kelvin or $-273^{\circ}C$.

2- In a substance, the majority of the molecules move from higher to lower concentration.

3- There are some that move from low to high although the overall movement is thus from high to low concentration. Eventually, the molecules reach a state of equilibrium.

Importance

1- Diffusion is one principle method of movement of substances within cells, as well as across cell membrane.

2- CO_2, oxygen and glucose etc. can cross the cell membrane by diffusion.

3- Gaseous exchange in gills and lungs operates by this process.

4- Movement of glucose molecules from small intestine lumen into the blood capillaries of villi is another example of diffusion.

Passive Transport & Diffusion

Diffusion is a type of passive transport in which a cell does not expend energy when molecules diffuse across its membrane.

(ii) Facilitated diffusion

Definition

It is a type of diffusion which takes place with the help of transport proteins is called facilitated diffusion.

Explanation

The molecules of some substances because of their size or charge cannot pass into or out of the cell through the cell membrane. This is brought about by certain protein called transport protein. The rate of facilitated diffusion is higher than simple diffusion. Facilitated diffusion is also a type of passive transport because there is no expenditure of energy in this process.

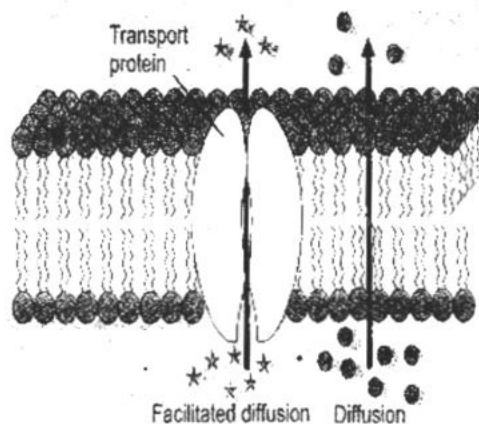



Figure 4.22: Diffusion and facilitated diffusion through cell membrane

(iii) Osmosis

Definition Osmosis is the movement of water molecules across a semi-permeable membrane from a solution of lesser solute concentration to a solution of higher solute concentration.

Explanation (Concept of Tonicity)

The rules of osmosis can be best understood through the concept of tonicity of solutions.

Tonicity of Solutions

The term tonicity refers to the relative concentration of solutes in the solutions being compared.

Hypertonic solutions

A hypertonic solution has relatively more solute.

Hypotonic solutions

A Hypotonic solution has relatively less solute.

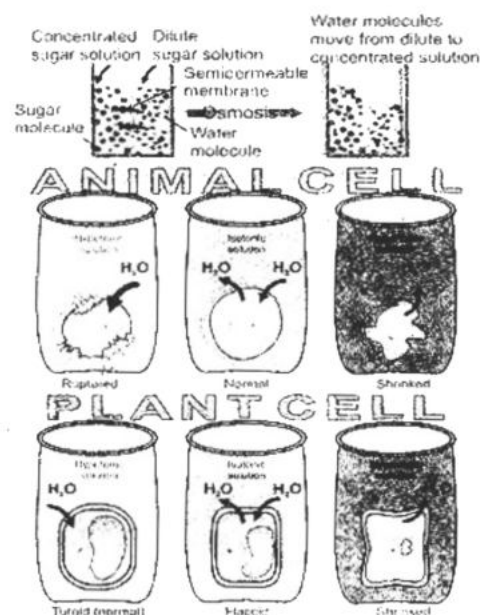



Figure 4.23: Effect of tonicity on animal and plant cell

Isotonic solutions Isotonic solutions have equal concentrations of solutes.

Effect of tonicity on animal cells or Water Balance Problems in Animal Cells

Animal Cell in Isotonic Solution

When an animal cell i.e. red blood cell is placed in an isotonic solution the cell volume remains constant because the rate at which water is entering the cell is equal to the rate at which it is moving out.

Animal Cell in Hypotonic Solution

When a cell is placed in a hypotonic solution, water enters and the cell swells and may rupture like an over-filled balloon.

Animal Cell in Hypertonic Solution

Similarly an animal cell placed in a hypertonic solution will lose water and will shrink in size.

So in hypotonic environment (fresh water) animal cells must have ways to prevent excessive entry of water in hypertonic environment (sea water). They must have ways to prevent excessive loss of water.

Effect of tonicity on Plant cell or Water Balance Problem in Plant Cell

Plant Cell in Hypotonic Solution

When plant cell is placed in hypotonic environment, water tends to move first inside the cell and then inside the vacuole. When vacuole increases in size, cytoplasm presses firmly against the interior of the cell wall which expands a little. Due to strong cell wall, plant cells does not rupture but instead becomes rigid. In this condition the outward pressure on cell wall exerted by internal water is known as turgor pressure and this phenomenon is known as turgor.

Plant Cell in Isotonic Solution

In isotonic environment, the net uptake of water is not enough to make the cell turgid and it is flaccid.

Plant Cell in Hypertonic Solution

In a hypertonic environment, a plant cell loses water and cytoplasm shrinks. The shrinkage of cytoplasm is called **plasmolysis.**

(iv) Filtration

Definition

Filtration is a process by which small molecules are forced to move across semi-permeable membrane with the aid of hydrostatic (water) pressure or blood pressure.

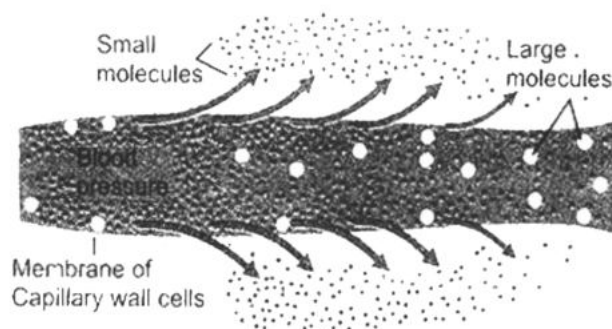



Figure 4.24: Filtration through the cell membrane of capillary wall

Example

In the body of an animal, blood pressure forces water and dissolved molecules to move through the semi-permeable membranes of the capillary wall cells. In filtration, the pressure cannot force large molecules such as proteins to pass through the membrane pores.

(v) Active Transport:

Definition:

Active transport is the movement of molecules from an area of lower concentration to the area of higher concentration. This movement against the concentration gradient requires energy in the form of ATP.

Figure 4.25: Sodium-potassium pump, showing active transport

Example:

The membranes of nerve cells have carrier proteins in the form of sodium potassium pump. In a resting (not conducting nerve impulse) nerve cell, this pump spends energy (ATP) to maintain higher concentrations of K^+ and lower concentrations of Na^+ inside the cell. For this purpose, the pump actively moves Na^+ to the outside of the cell where they are already in higher concentration and K^+ to the inside of the cell where they are in higher concentration.

(vi) Endocytosis

Definition

It is the process of cellular ingestion of bulky materials by the infolding of cell membrane.

Figure 4.26: Endocytosis and Exocytosis

Forms of Endocytosis

There are two forms of endocytosis

(i) Phagocytosis (Cellular Eating)

(ii) Pinocytosis (Cellular Drinking)

In phagocytosis, cell takes in solid material while in pinocytosis cell takes in liquid in the form of droplets.

(vii) Exocytosis

It is the process through which bulky material is exported.

❖ This process adds new membrane which replaces the part of cell membrane lost during endocytosis.

Q.25. What are tissues and colony of cells?

Ans. Tissue

A group of similar cells specialized for the performance of a common function.

Colony of Cells

In a colony there are many cells and each cell performs all general functions on its own. Such a group does not get tissue level of organization because in cells coordination is absent.

Q.26. What is the role of turgor?

Ans. The turgor of cells is responsible for maintaining shapes of non-woody plants and soft portions of trees and shrubs.

Q.27. How does the tonicity of solution effect the guard cells?

Ans.

(i) Stomata

Stomata (openings) in leaf epidermis are surrounded by guard cells.

(ii) Opening of Stomata

During daytime, guard cells are making glucose and so are hypertonic than their nearby epidermis cells. Water enters them from other cells and they swell. In this form, they assume a rigid bowed shape and a pore is created between them.

(iii) Closing of Stomata

At night when there is low solute concentration in guard cells, water leaves them and they become flaccid. In this form, both guard cells rest against one another and the opening is closed.

Q.28. Describe application of knowledge about semi-permeable membranes.

Ans. Introduction

The knowledge about semi-permeable membrane is applied for various purposes.

(i) Separation of Substances

Semi-permeable membrane is capable of separating substances.

(ii) Separation of bacteria from viruses

Artificially synthesized semi-permeable membranes are used for separation of bacteria from viruses, because bacteria cannot cross a semi-permeable membrane.

(iii) Membrane Based Filtration Systems

In advanced water-treatment technologies, membrane-based filtration systems are used. In this process, semi-permeable membranes separate salts from water (reverse of osmosis).

Q.29. Describe different types of Animal Tissues.

Ans. Animal Tissues:

Animal tissues are of the following types.

1. Epithelial Tissues
2. Connective Tissues
3. Muscle Tissues
4. Nervous Tissues

(1) Epithelial Tissues (Lahore board 2012 G I)

Location

Epithelial tissue covers the outside of the body and lines organs and cavities.

Structure

The cells in this type of tissue are very closely packed together.

Types

This tissue has many types on the basis of the shape of cells as well as the number of cell layers.

(i) Squamous Epithelium

Structure:

It consists of a single layer of flat cells.

Location:

These are found in lungs, heart and blood vessels etc.

Function: They allow the movement of materials across it.

Squamous epithelium

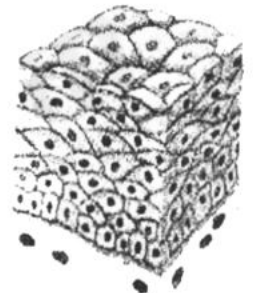
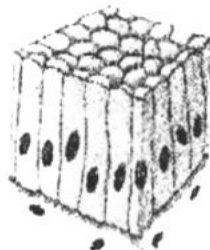
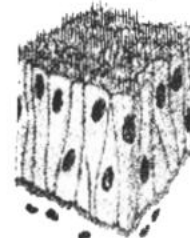
Cuboidal epithelium

Stratified squamous epithelium

Columnar epithelium

Ciliated columnar epithelium

Figure 4.27: Epithelial tissues in animals

(ii) Cuboidal Epithelium

Structure

It consists of a single layer of cube-shaped cells.

Location

These are found in kidney tubes and small glands.

Function

It makes secretions.

(iii) Columnar epithelium

Structure

It consists of single layer of elongated cells.

Location: They are found in alimentary canal and gallbladder etc.

Function: It causes enzyme secretions.

(iv) Ciliated Columnar Epithelium

Structure They are elongated cells with cilia.

Location These are found in trachea and bronchi.

Function It propels mucous by ciliary action.

(v) Stratified Squamous Epithelium:

Structure

It consists of many layers of flat cells.

Location

These are found in the lining of oesophagus, mouth and also the skin.

Function

It protects the inner parts.

(2) Connective Tissues

As the name shows, connective tissues serves a "connecting" function.

Function

It supports and binds other tissues. Unlike epithelial tissue, connective tissue has cells scattered throughout an extracellular matrix.

Example

Common examples of this tissue are:-

i. Cartilage

(found around the ends of bones, in external ear, nose, trachea etc.),

ii. Bones. (hard connective tissue)

iii. The adipose tissue

(found around kidneys, under skin, in abdomen etc.) is also a type of connective tissue. It provides energy and support to the organs

iv. Blood.

Figure 4.28: Connective tissues in animals

Blood is special type called semifluid connective tissue

(3) Muscle Tissue **(Lahore board 2012 G I)**

Structure

Muscle tissue consists of bundles of long cells called muscle fibres.

Function

The cells of this tissue have ability to contract.

Types:

They are of three types:

(i) Skeletal Muscles

Structure

Their cells are striated (striped).

Skeletal muscles

Location

They are found attached to bones.

Function

They are responsible for the movements of bones. They are voluntary in action i,e. Their contraction is under the control of our will.

(ii) Smooth Muscles

Structure

They contain non-striated cells, each contains a single nucleus. They are involuntary in action i.e., their contraction is not under the control of our will.

Location

They are found in the walls of alimentary canal, urinary bladder and blood vessels.

Smooth muscles

Function

These are responsible for the movement of substances.

(3) Cardiac Muscles **(Lahore board 2012 G II)**

Structure

Their cells are also striated. They are involuntary in action. There is a single nucleus in each cell.

Location

They are found in the walls of the heart.

Function

They produce heart beat.

Figure 4.29 Types of muscle tissue

(4) Nervous Tissues

Structure

This tissue is mainly composed of nerve cells or neurons which are specialized to conduct messages in the form of nerve impulses.

Location

They are found in nerves, spinal cord and brain.

Function

They are responsible for communication among body parts.

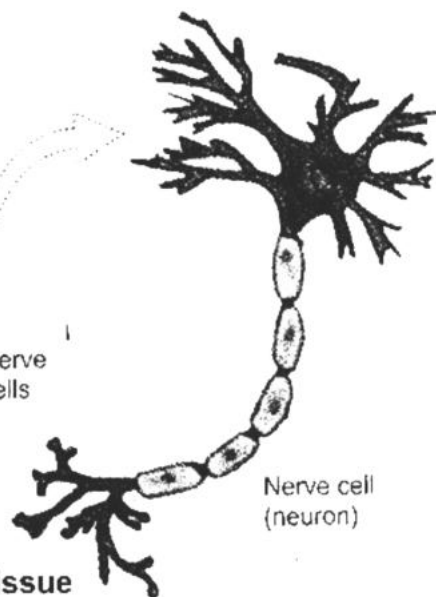
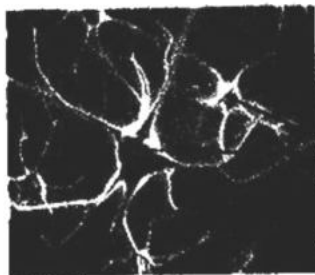



Figure 4.30: Nervous tissue

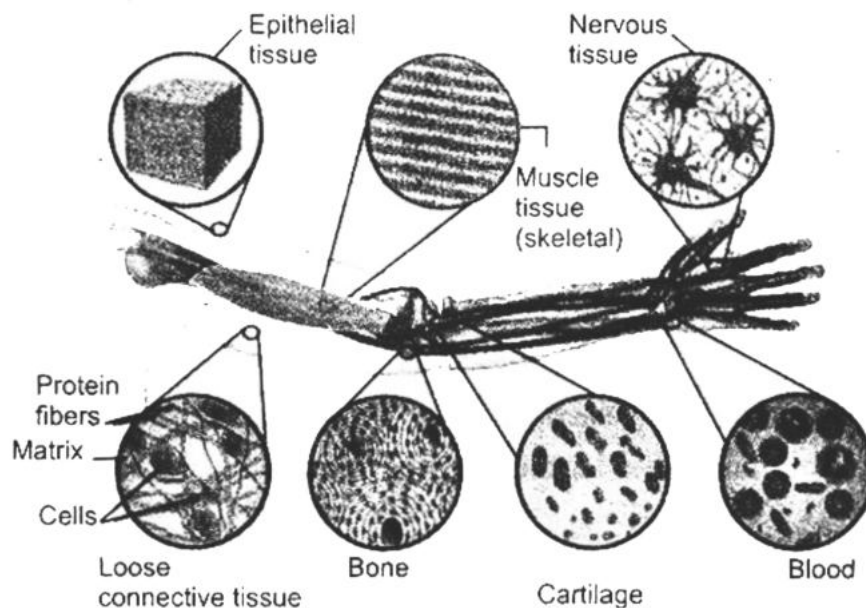



Figure 4.31: Different tissues in human body

Q.30. Describe the different types of plant tissues.

Ans. Plant Tissues

These are of two types:

1. Simple Tissues 2. Compound Tissues

(1) Simple Tissues

Definition The tissues which are made of single type of cells are called simple tissues.

Types They are further divided in the following types.

(i) Meristematic tissues

(ii) Permanent tissues

(i) Meristematic Tissues:

Introduction: These tissues are composed of cells which have ability to divide.

Characteristics:

(i) Cells are thin walled.

(ii) Having large nucleus

(iii)Small vacuole or no vacuole.

(iv)No inter-cellular spaces present in them.

Types There are two main types of meristematic tissues:

(i) Apical Meristems: **(Lahore board 2011 G II) (short question)**

They are located at the apices or tips of roots and shoot. When they divide they cause increase in the length of plant. Such a growth is called primary growth.

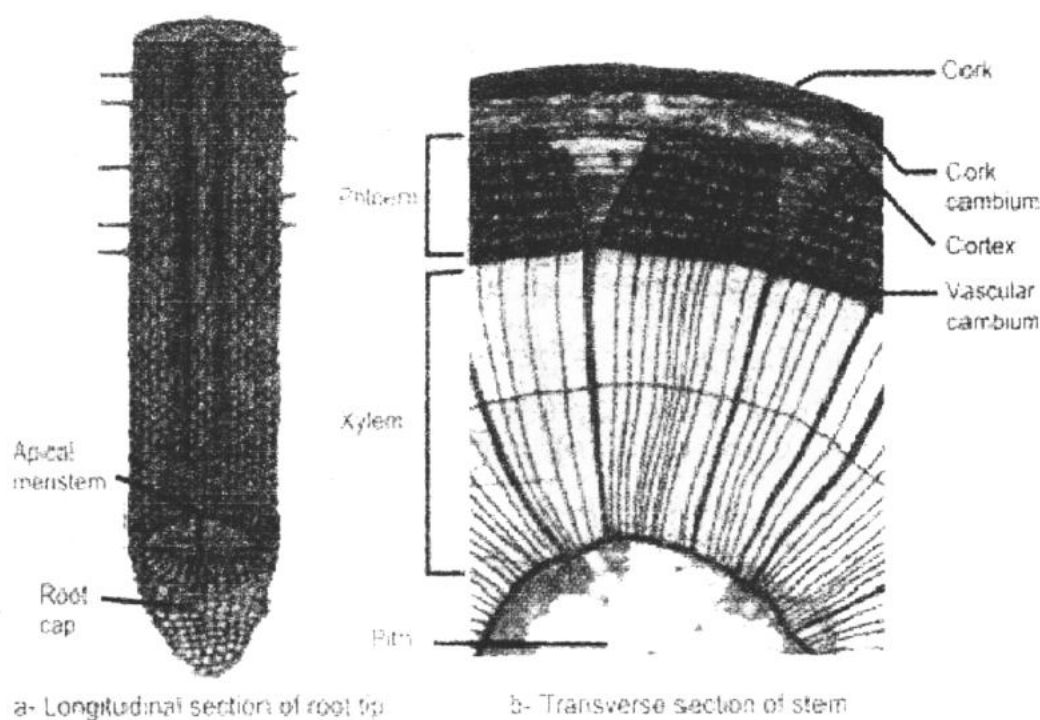



Figure 4.32: a-Apical meristem at root tip and b- Vascular and cork cambium in stem

(ii) Lateral Meristems:

Location

They are located on the lateral sides of roots and shoots.

Function

By dividing they are responsible for increase in growth of plant part. Such a growth is called secondary growth.

Types

They are further of two types i.e.

(a) Vascular cambium (b) `Cork cambium

(a) Vascular Cambium

Vascular cambium is present between the xylem and phloem tissue.

(b) Cork Cambium

Cork cambium is present in the outer lateral sides of plant.

(iii) Intercalary Meristem

It is in the form of small patches among the mature tissues. These are common in grasses and help in the regeneration of parts removed by herbivores.

(ii) Permanent Tissues

Introduction

Permanent tissues originate from meristematic tissues. These tissues are composed of cells, which do not have the ability to divide.

Types of Permanent Tissues

These are of the following types.

1. Epidermal tissues 2. Ground tissues 3. Support tissues

(1) Epidermal tissues:

Introduction

Epidermal tissues are composed of a single layer of cells and they cover plant body.

Functions (Lahore board 2012 G I)

They act as a barrier between the internal plant tissues and the environment. They are also responsible for the absorption of water and minerals in roots. On stem and leaves they secrete cutin which prevents evaporation.

Epidermal tissues also have some specialized cells that perform specific functions. For example

(i) Root Hairs

(ii) Stomata

Figure 4.33: Epidermal tissue

(2) Ground Tissues

Introduction

They are simple tissues made up of parenchyma cells.

Shape: They are spherical.

Functions

❖ They have thin primary cell walls and have large vacuoles for storage of food.

❖ In the leaves, they have sites of photosynthesis and in other parts, they are the sites for respiration and protein synthesis.

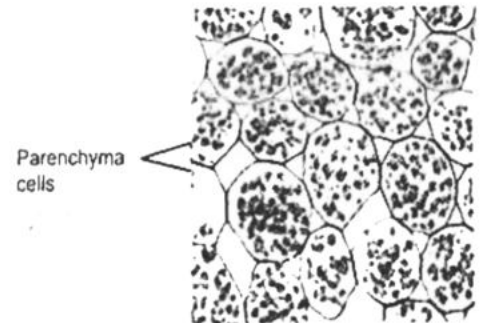



Figure 4.34: Ground tissue

(3) Supporting Tissues

Introduction

These tissues provide strength and flexibility to the plants.

Types: They are of two types:

(a) Collenchyma Tissues

Location

They are found just beneath the epidermis in the cortex of young herbaceous stems and in the midribs of leaves and in petals of flowers.

Structure

They are made of elongated cells with unevenly thickened primary cell walls. They are flexible.

Function: Their function is to support the organs in which they are found.

Figure 4.35: Collenchyma tissue

(b) Sclerenchyma

❖ They are composed of cells with rigid secondary cell walls.

❖ Their cell walls are hardened with lignin, which is the main chemical component of wood.

❖ Mature sclerenchyma cells cannot elongate and most of them are dead.

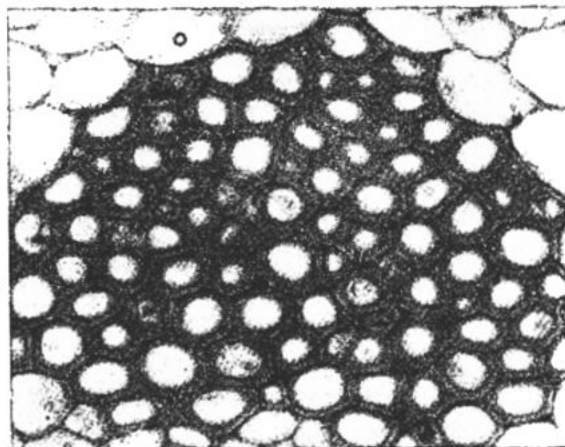



Figure 4.36: Sclerenchyma tissue

(iv) Compound (Complex) Tissues

Introduction A plant tissues composed of more than one type of cells performing a common function is called compound or complex tissues e.g., xylem and phloem tissues.

Xylem Tissues

Functions

❖ Xylem tissue is responsible for the transport of water and dissolved substances from roots to aerial parts.

❖ They provide support to plant body because of presence of ligin in its secondary cell walls. Lignin makes these walls thick and rigid.

Figure 4.37: Xylem tissue

Types of Cell

Following types of cells are found in xylem tissues:

(a) Vessel Elements or Cells

❖ Vessel elements have thick secondary cell walls.

❖ They lack end walls and join together to form long tubes.

(b) Tracheids

❖ These are slender cells with overlapping ends.

Phloem Tissues (Lahore board 2012 G I)

Functions

They are responsible for the conduction of dissolved organic matter (food) between different parts of plant body.

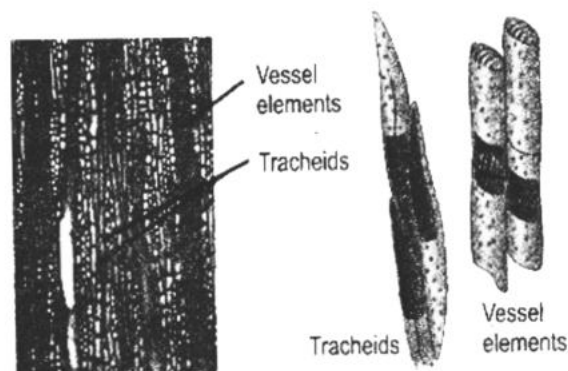
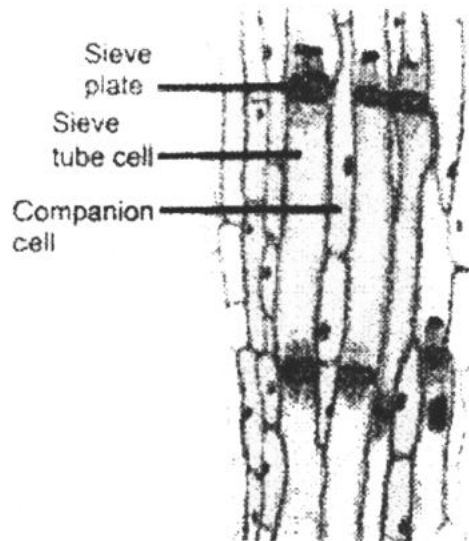



Figure 4.38: Phloem tissue

Types of Cells

Following types of cells are found in phloem tissues.

(a) Sieve tube cells:

- These are long cells and their end walls have small pores called sieve plates.
- Many sieve tube cells join to form long sieve tubes.

(b) Companion Cells:

Companion cells make proteins for sieve tube cells.

Multiple Choice Questions

1. Which of these clues would tell you whether a cell is prokaryotic or eukaryotic?

(a) The presence or absence of a cell wall.

(b) Whether or not the cell is partitioned by internal membranes.

(c) The presence or absence of ribosomes.

(d) Whether or not the cell contains DNA

2. There are _____ micrometers (μm) in one millimeter (mm).

(a) 10 (b) 100

(c) 1000 (d) $\frac{1}{1000000}$

3. The plasma membrane does all of these except _____________.

(a) Contains the hereditary material.

(b) Acts as a boundary or border for the cytoplasm.

(c) Regulates passage of material in and out of the cell.

(d) Functions in the recognition of cell.

4. Which of these material is not a component of the plasma membrane?

(a) Lipids (b) Carbohydrates
(c) Proteins (d) DNA

5. Cell walls are found in these organisms, except for _____.
(a) Plants (b) Animals
(c) Bacteria (d) Fungi

6. The _______ is a major component of plant cell walls.
(a) Chitin (b) Peptidoglycan
(c) Cellulose (d) Cholesterol

7. Plant cells have ______ and ____ which are not present in animal cells.
(a) Milotochondria, Chloroplasts
(b) Cell membranes, cell walls
(c) Chloroplasts, nucleus
(d) Chloroplasts, cell wall

8. The ______ is the membrane-enclosed structure in eukaryotic cells that contains the DNA of the cell.
(a) Mitochondrion(b) Chloroplast
(c) Nucleolus (d) Nucleus

9. Ribosomes are constructed in the _____________.
(a) Endoplasmic reticulum
(b) Nucleoid
(c) Nucleolus (d) Nuclear Pore

10. Rough endoplasmic reticulum is the area in a cell where ______ are synthesized.
(a) Polysaccharides (b) Proteins
(c) Lipids (d) DNA

11. Smooth endoplasmic reticulum is the area in a cell where______are synthesized.
(a) Polysaccharides (b) Proteins
(c) Lipids (d) DNA

12. The mitochondrion function in
(a) Lipid storage (b) Protein synthesis
(c) Photosynthesis
(d) Cellular respiration

13. The thin extensions of the inner mitochondrial membrane are known as _____.
(a) Cristae (b) Matrix
(c) Thylakoids (d) Stroma

14. The chloroplast functions in _____.
(a) ATP synthesis (b) Protein synthesis
(c) Photosynthesis
(d) DNA replication

15. Which of these cellular organelles have their own DNA?
(a) Chloroplast (b) Nucleus
(c) Mitochondrion (d) All of these

16. Who described cells first?
(a) Robert Hooke (b) Leeuwenhook
(c) Robert Brown
(d) Schleiden & Schwann

17. Which one are the sites of protein synthesis?
(a) Nucleus (b) Mitochondria
(c) Endoplasmic Reticulum
(d) Ribosomes

18. The smallest cells of bacteria are called:
(a) Plasmodesmata
(b) Plasma membrane
(c) Mycoplasmas (d) Plasmolysis

19. Xylem and phloem tissues are examples of:

(a) Simple Tissues
(b) Compound tissues
(c) Meristematic Tissues
(d) None

20. Cellular eating is called:
(a) Pinocytosis (b) Endocytosis
(c) Phagocytosis (d) None

21. Which of the following movement requires energy in the form of ATP?
(a) Diffusion (b) Osmosis
(c) Active transport
(d) Facilitated diffusion

(Lahore board 2011 G II)

22. The example of bulkiest cells are:
(a) Bacteria (b) Bird eggs
(c) Muscle cells (d) Nerve cells

23. The example of long cells are:
(a) Bird eggs (b) Muscle cells
(c) Never cells
(d) Muscle cells & nerve cells

24. Human body is made up of how many types of cells?
(a) 200 (b) 300
(c) 400 (d) 500

25. Who reported that all animal tissues are also composed of individual cells?
(a) Robert Hooke
(b) Lorenz Oken (c) Robert Brown
(d) Schwann

26. Nucleus in the cell was discovered by:
(a) Robert Hooke (b) Lorenz Oken
(c) Robert Brown (d) Schwann

27. Cell theory was proposed by:
(a) Robert Hooke (b) Schwann
(c) Schleiden (d) Both a and b

28. Concept of "Omnis cellula e cellula" was given by:
(a) Robert Hooke (b) Lorenz Oken
(c) Robert Brown (d) Virchow

29. The cells used for transport of impulses are:
(a) muscles cells (b) nerve cells
(c) gland cells (d) RBC

30. The cells used for secretion of hormones are:
(a) muscles cells (b) nerve cells
(c) gland cells (d) RBCs

31. The cells used for support in plants are:
(a) Sclerenchymatous cells
(b) Collenchymatous cells
(c) Parenchymatous cells
(d) Both a and b

32. The cells used for photosynthesis in plants are:
(a) Sclerenchymatous cells
(b) Ground tissues
(c) Phloem tissues
(d) Meristematic cells

33. The cells used for storage in plants are:
(a) Sclerenchymatous cells
(b) xylem tissues
(c) Parenchymatous cells
(d) Meristematic cells

34. The cells which can divide in plants are:
(a) Sclerenchymatous cells
(b) Collenchymatous cells
(c) Parenchymatous cells
(d) Meristematic cells

35. The resolution of human eye is:
(a) 1.0 (b) 2.0
(c) 0.1 (d) 0.2

36. Magnification of electron microscope is:

(a) 2500 x (b) 25000 x

(c) 250000 x (d) None

37. The movement of molecules against the concentration gradient is called:

(a) Diffusion

(b) Passive transport

(c) active transport

(d) Endocytosis

38. Cellulose is present in:

(a) Primary wall

(b) Secondary wall

(c) Middle lamella

(d) None of the above

39. Lignin is present in:

(a) Primary wall

(b) Secondary wall

(c) Middle lamella

(d) None of the above

40. Lysosomes were discovered by:

(a) Sanger (b) Palade

(c) De Duve (d) Brown

41. The inner chamber of the mitochondria contains a fluid is called:

(a) Cristae (b) Matirx

(c) F_1 particles (d) None of the above

42. Which of the following are colourless and store starch, proteins and lipids?

(a) Chloroplasts

(b) Chromoplasts

(c) Leucoplasts

(d) None

43. The stacked membranous structure in the chloroplast is

(a) Thylakoids (b) Stroma

(c) Grana (d) Intergranum

44. The membranous structure in the chloroplast is:

(a) Thylakoids (b) Stroma

(c) Grana (d) Intergranum

45. The fluid within the chloroplast is:

(a) Thylakoids (b) Stroma

(c) Grana (d) Intergranum

46. The plastids present in fruits are:

(a) chloroplasts (b) Chromoplasts

(c) Leucoplasts (d) All of the above

47. The plastids present in roots are:

(a) chloroplasts (b) Chromoplasts

(c) Leucoplasts (d) All of the above

48. The structure present in the prokaryotes is:

(a) Mithochoridria (b) Ribosomes

(c) ER (d) Golgi bodies

49. Responsibility of protein synthesis is:

(a) Plastids (b) Ribosomes

(c) Golgi apparatus (d) Lysosomes

(Lahore board 2011 G II)

50. Polymer of amino acid and sugar is:

(a) Peptidoglycan (b) Glycolipids

(c) Phospholipids (d) Glycogen

(Lahore board 2011 G II)

51. Xylem tissues consist of vessel elements and:

(a) Sieve tube **(b) Tracheids**

(c) Mesophyll **(d) Fibre cell**

(Lahore board 2011 G I)

52. Primary cell wall of plants has a chemical:

(a) Cellulose (b) Peptidoglycan

(c) Glycolipids (d) Proteins

(Lahore board 2011 G I)

Answers

1.	b	4.	d	7.	d	10.	b	13.	a	16.	a	19.	B	22.	B
2.	c	5.	b	8.	d	11.	c	14.	c	17.	d	20.	C	23.	D
3.	a	6.	c	9.	c	12.	d	15.	c	18.	c	21.	C	24.	A
25	d	26	c	27	d	28	d	29	b	30	c	31	d	32	B
33	c	34	d	35	c	36	c	37	c	38	a	39	b	40	C
41	b	42	c	43	c	44	a	45	b	46	b	47	c	48	B
49	b	50	a	51	b	52	a								

Short Questions

Q:1. What is Active Transport?

Ans. Active transport is the movement of molecules from an area of lower concentration to the area of higher concentration. This movement against the concentration gradient requires energy in the form of ATP.

Q:2. Define Cell.

Ans. The structural and functional unit of living organisms is known as cell or cells are the smallest living things. It is the basic unit of organization of all organisms.

Q:3. What is Cell Membrane?

Ans. All prokaryotic and eukaryotic cells have a thin and elastic cell membrane covering the cytoplasm. Chemical analysis reveals that:

Cell membrane is mainly composed of proteins and lipids with small quantities of carbohydrates.

Cell membrane functions as a semi permeable barrier, allowing a very few molecules across it.

Q:4. Write salient features of Cell Theory.

Ans. It was presented by schleiden and shwann. The salient features of cell theory are:

i. All organisms are composed of one or more cells.
ii. Cells arise only by divisions in previously existing cells.
iii. Cells are the smallest living things, the basic unit of organization of all organisms.

Q:5. What is Cell Wall?

Ans. The cell wall is a non-living strong component of the cell and it is located outside the plasma membrane.

Plant cells have a variety of chemicals incorporated in their cell walls.

It provides shape, strength, protection and support to the inner living matter (Protoplasm) of the cell.

Q:6. Define Centriole.

Ans. Animals and many unicellular organisms have hollow and cylindrical organelles known as centrioles.

Their function is to help in the formation of spindle fibres during cell division. In the cells that contain cilia or flagella, centrioles are involved in the formation of cilia and flagella.

Q:7. What is Chloroplast?

Ans. Chloroplast is a type of plastid bound by a double membrane. It is found in plant cells. Chloroplasts are the sites of photosynthesis in eukaryotes. They contain chlorophyll, the green pigment necessary for photosynthesis.

Q:8. What is Chromoplast?

Ans. The second type of plastid in plant cells is chromoplast. They contain pigments associated with the bright colours and are present in the cells of flower petals and fruits. Their function is to give colour to their parts and thus help in pollination.

Q:9. What are Connective Tissues?

Ans. Connective tissue typically has cells scattered throughout an extra cellular matrix. Connective tissue serves a "Connecting" function. It supports and binds other tissues.

Q:10. What is Cytoplasm?

Ans. Cytoplasm is defined as the material between the plasma membrane (Cell membrane) and the nuclear envelope. It is a semi-viscous and semi-transparent substance. The cytoplasm of all the cell provides space for the proper functioning of the organelles and also acts as the site for various biochemical reactions.

Q:11. Define Diffusion.

Ans. Diffusion is the net movement of a substance from an area of higher concentration to the area of lower concentration i.e. along concentration gradient.

Q:12. What is Endoplasmic Reticulum?

Ans. It is a network of interconnected channels that extends from cell membrane to the nuclear envelope. RER serves a function in protein synthesis while SER involved in lipid metabolism and in the transport of materials from one part of the cell to the other.

Q:13. Define Epithelial Tissue.

Ans. Epithelial tissue covers the outside of the body and lines organs and cavities. The cells in this type of tissue are very closely packed together.

Epithelial tissue helps to protect the inner parts, movement of material and make secretions.

Q:14. Define Facilitated Diffusion.

Ans. It is a type of passive transport in which molecules are taken into or out of the cells with the help of transport proteins present in cell membranes. There is no expenditure of energy in this process.

Q:15. What are Golgi apparatus?

Ans. These are set of flattened sacs (cisternae) that are stacked over each other in plant and animal cells. It modifies molecules coming from rough ER and packs them into small membrane bound sacs. These sacs can be transported to various locations in the cell or to its exterior in the form of secretions.

Q:16. Define Hypertonic Solutions.

Ans. These are those solutions which have relatively more solute.

Q:17. Define Hypotonic Solutions.

Ans. These are those solutions which have relatively less solute.

Q:18. Define Isotonic Solutions.

Ans. Isotonic solutions have equal concentrations of solutes.

Q:19. What are Leucoplasts?

Ans. Leucoplasts are the third type of plastids. They are colourless and store starch, proteins and lipids. They are present in the cells of those parts where food is stored.

Q:20. Define Lysosomes.

Ans. These are single membrane bounded organelles. Lysosomes contain strong digestive enzymes and work for the breakdown (digestion) of food and waste materials within the cell.

Q:21. What is Mitochondrion?

Ans. Mitochondrion is the double membrane bounded structures found only in eukaryotes. These are the sites of aerobic respiration, and are the major energy production centre.

Q:22. What is Muscle Tissue?

Ans. Muscle tissue consists of bundles of long cells called muscle fibres. It is the most abundant tissue in a typical animal cell. The cells of this tissue have ability to contract.

Q:23. What do you know about Nucleus?

Ans. It is most important organelle of eukaryotic cells. In animal cells, it is present in the center while in a mature plant cells, due to the formation of large central vacuole, it is pushed to side. The nucleus is bounded by a double membrane known as nuclear envelope. Inside the nuclear envelope, a granular matrix, the nucleoplasm, one or two nucleoli and chromosomes are present. Nucleus controls all activities of cell.

Q:24. Define an Organelle.

Ans. These are small structures within the eukaryotic cells that perform specific functions e.g. mitochondrion, ribosomes, Golgi bodies, nucleus etc.

Q:25.Define Osmosis.

Ans. Osmosis is the movement of water across a semi-permeable membrane from a solution of lesser solute concentration to a solution of higher solute concentration.

Q:26.What is Passive transport?

Ans. It is a type of transport in which a cell does not spend energy when molecules moves across its membrane from a region of higher concentration to a region of lower concentration.

Q:27. Define Phagocytois (cellular eating).

Ans. It is a form of endocytosis in which cell takes in solid material.

Q:28. Define Pinocytosis (Cellular Drinking).

Ans. It is a form of endocytosis in which cell takes in liquid in the form of droplets.

Q:29. What is Plasmolysis?

Ans. In a hypertonic environment, a plant cell loses water, causing the cytoplasm to shrink within the cell wall. The shrinking of cytoplasm is called plasmolysis.

Q:30. What are Plastids? **(Lahore board 2011 G II)**

Ans. Plastids are also membrane bounded organelles that only occur in plants and photosynthetic protists (algae). They are of three types i.e. chloroplasts, leucoplasts and chromoplasts. Chloroplasts are the sites of photosynthesis while chromoplasts help in pollination and dispersal of fruits and leucoplast help in storage.

Q:31. What are Ribosomes? **(Lahore board 2011 G I)**

Ans. Ribosomes are tiny granular structures that are either floating freely in the cytoplasm or are bound to the endoplasmic reticulum (ER). Ribosomes are the sites of protein synthesis.

Q:32. Define semi-permeable Membrane.

Ans. It is a membrane which allows a very few molecules across it while fencing the majority of chemicals inside the cell.

Q:33. What is Tissue?

Ans. A group of cells specialized for the performance of a common function is called a tissue

Q:34. What is Turgor Pressure?

Ans. When cell is placed in a hypotonic environment, water is entered in the cell and makes the cell rigid. The internal pressure of such a rigid cell on the cell wall by the water is known as turgor pressure and this phenomenon is known as turgor.

Q:35. Define Vacuole.

Ans. Vacuoles are fluid filled single membrane bounded organelles. They are of different types. They help to digest the material with the help of lysosomes and elimination of wastes from their bodies.

Q:36. Define Microfilament.

Ans. Microfilament is one of the most important filament that make up the cytoskeleton. It is made of actin subunits. These are often used by cells to change their shapes and to hold structures.

Q:37. Define Microtubule.

Ans. Microtubule is another most important filament that make up the cytoskeleton. It is made of tubulin subunits and are often used by cells to hold their shape.

Unit 05

CELL CYCLE

Q.1. Define reproduction. Describe its importance in life.

Ans. The most basic characteristic of life is reproduction.

Definition

It is a biological process in living things by which they produce their young ones which are similar to parents.

Levels of Reproduction

Reproduction occurs at different levels of organization.

(i) Parts of the cell such as the chromosomes produce new chromosomes.

(ii) Cells then produce new cells

(iii) Individuals produce offsprings like themselves.

Reproduction for continuation of life

Rudolf Virchow proposed an important biological principle that all cells come from pre-existing cells. This principle tells us that the continuation of life, including all aspects of reproduction, is based on the reproduction of cells. We commonly refer cellular reproduction as cell division and it is a part of whole life of a cell i.e. cell cycle.

Q.2. Define cell cycle. Describe its phases. (Lahore board 2011 G II)

Ans. Definition:

Cell cycle is the series of events from the time a cell is produced until it completes mitosis and produces new cells.

Phases of cell cycle

The cell cycle consists of two major phases i. e.

(i) **Interphase** (ii) **Mitotic phase (M phase)**

The mitotic phase is a relatively short period of cell cycle. It alternates with the much longer interphase, where the cell prepares itself for division. Typically interphase lasts for at least 90% of the total time required for cell cycle.

Q.3. Define interphase. Explain the stages of interphase. (Lahore board 2011 G II)

Ans. Definition:

Interphase is the time when a cell's metabolic activity is very high, as it performs its various functions.

Stages of interphase

It is divided into three phases.

G1 (first gap)

S (synthesis)

G2 (second gap)

G1 Phase

After its production, a cell starts its cell cycle in G1 phase. During this phase,

(i) The cell increases its supply of proteins,

(ii) Cell increases the number of its organelles (such as mitochondria, ribosomes)

(iii) Cell grows in size.

(iv) This phase is also marked by the synthesis of various enzymes that are required in the next phase i.e. S phase, for the duplication of chromosomes.

S Phase

In this phase, DNA replication takes place, as a result the cell duplicates its chromosomes.

As a result, each chromosome consists of two sister chromatids.

G2 Phase

In the G2 phase, the cell prepares proteins that are essential for mitosis, mainly for the production of spindle fibres.

After the G2 phase of interphase, the cell enters in the division phase i.e. M phase. It is characterized by mitosis, in which the cell divides into the two daughter cells.

Q.4. Write a brief note on G0 Phase.

Ans. G0 Phase

Eukaryotic or Multicellular Cells

Definition

Cells that have temporarily or permanently stopped dividing are said to have entered a state of quiescence called GO Phase.

In multicellular eukaryotes, cells enter the G0 state from G1 and stop dividing. Some cells remain in GO for indefinite period e.g. neurons. Some cells enter GO phase semi-permanently e.g. some cells of liver and kidneys. Many cells such as epithelial cells, do not enter G0 and continue to divide throughout an organism's life.

Figure 5.1: The eukaryotic cell cycle

Note: The events of cell cycle are ordered

and directional i.e. each event occurs in a sequential fashion and it is impossible to "reverse" the cycle.

Q.5. What do you know about M-Phase?

Ans. After the G2 Phase of interphase, the cell enters the division phase i.e. M-phase. It is characterized by mitosis, in which cell divides into two daughter cells.

Q.6. What is mitosis? Describe its discovery and phases.

Ans. Definition

Mitosis is the type of cell division in which a cell divides into two daughter cells, each with the same number of chromosomes as were present in parent cell.

Discovery of Mitosis

A German biologist Walther Flemming in the 1880's observed that in a dividing cell, the nucleus passes through a series of changes which he called mitosis.

Occurrence of Mitosis

Mitosis occurs in eukaryotic cells. In multicellular organisms, the somatic cells undergo mitosis. Prokaryotic cells undergo a process similar to mitosis called binary fission.

Somatic Cells and Germ line Cells

Somatic cells are those which are forming the body of organisms while germ line cells are those which give rise to gametes. Somatic cells undergo mitosis while germ line cells undergo meiosis.

Phases of Mitosis

The process of mitosis is complex and highly regulated. The sequence of events is divided into two major phases

(i) The division of the nucleus is known as Karyokinesis.

(ii) The division of the cytoplasm is known as cytokinesis.

(i) KARYOKINESIS

The division of the nucleus is further divided into four phases

(i) Prophase

(ii) Metaphase

(iii) Anaphase

(iv) Telophase

(i) Prophase

Following changes occur in the nucleus during prophase.

(i) Condensation of chromatin

Normally, the genetic material in the nucleus is in a loose thread like form called **chromatin**. At the onset of prophase, chromatin condenses into highly ordered structures called chromosomes.

(ii) Structure of Chromosomes

Since the genetic material has already been duplicated earlier in S Phase, each chromosome is made of two sister chromatids, bound together at the same centromere. Each chromosome also has kinetochore at the centromere. A **kinetochore** is a complex protein structure that is the point where spindle fibers attach.

(iii) Duplication of Centrioles

There are two centrioles close to the nucleus which are collectively called centrosome. Each centriole duplicates and thus two daughter centrosomes are formed.

(iv) Formation of Mitotic Spindle

Both centrosomes migrate to the opposite poles of cell. The two centrosomes give rise to microtubules by (joining) the **tubulin protein** present in the cytoplasm. The microtubules thus formed are called spindle fibers and the complete set of the spindle fibres is known as mitotic spindle.

(v) Disappearance of Nucleolus and Nuclear Envelope

The nucleolus and the nuclear envelope have degraded and spindle fibres have invaded the central space.

(vi) Formation of Spindle fibres in plant cells

In highly vacuolated plant cells, the nucleus has to migrate into the centre of the cell before prophase. The cells of plants lack centrioles. So, spindle fibres are formed by the aggregation of tubulin proteins on the surface of the nuclear envelope during prophase.

(ii) Metaphase

(i) Attachment of kinetochore fibres

When the spindle fibres have grown to sufficient length, some of the spindle fibers, known as kinetochore fibres attach with the kinetochores of chromosomes. Two kinetochore fibres from opposite poles attach with each chromosome.

(ii) Formation of metaphase plate

Chromosomes arrange themselves along the equator of the cell forming a metaphase plate. A number of other fibres (non kinetochore) attach with each other from the opposite centrosomes.

(iii)Anaphase

(i) Separation of sister chromatids

When a kinetochore spindle fibre connects with the kinetochore of the chromosome, it starts to pull towards the originating centrosomes. The pulling force divides the chromosomes' sister chromatids, and they separate. These sister chromatids are now sister chromosomes, and they are pulled apart towards the respective centrosomes. The other spindle fibres (non-kinetochore) also elongate.

(ii) Formation of two identical set of chromosomes

At the end of anaphase, the cell has succeeded in separating identical copies of chromosomes into two distinct groups at the opposite poles.

(iv)Telophase

Telophase is a reversal of prophase. A new nuclear envelope forms around each set of separated chromosomes. Both sets of chromosomes, now surrounded by new nuclear envelopes, unfold back into chromatin. Nuclear division is completed, but cell division has yet one more step to complete.

(ii) Cytokinesis (Lahore board 2012 G I)

Cytokinesis is the division of cytoplasm.

CYTOKINESIS IN ANIMAL CELL

In animal cells, cytokinesis occurs by a process known as cleavage. A cleavage furrow develops where the metaphase plate used to be. The furrow deepens and eventually pinches the parent cell into two daughter cells.

CYTOKINESIS IN PLANT CELL

Cytokinesis in plant cells occurs differently. Vesicles derived from the Golgi apparatus move to the middle of the cell and fuse to form a membrane bounded disc called the cell plate or **Phragmoplast**. The plate grows outward and more vesicles fuse with it. Finally, the membranes of the cell plate fuse with the plasma membrane and its contents join the parent cell wall. The result is two daughter cells, each bounded by its own plasma membrane and cell wall.

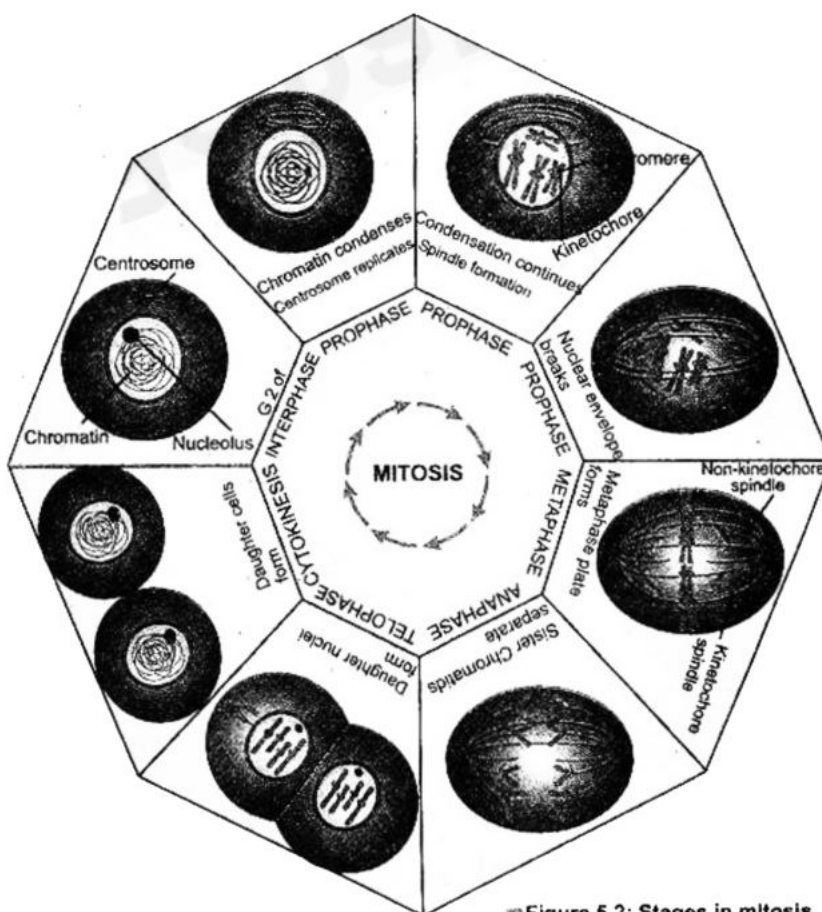



Figure 5.2: Stages in mitosis

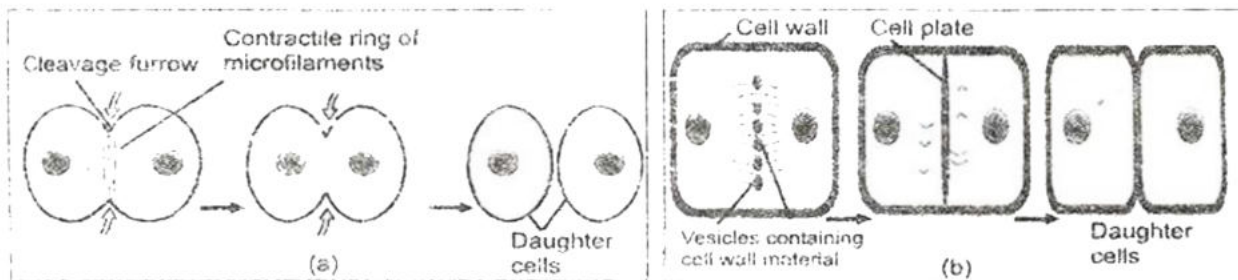



Figure 5.3: Cytokinesis; (a) in animal cell, (b) in plant cell

Q.7. Describe the significance of mitosis?

Ans.

(i) Maintenance of chromosome set

The importance of mitosis is the maintenance of the chromosomal set i.e. each daughter cell receives chromosomes that are alike in composition and equal in number to the chromosomes of the parent cell.

(ii) Development and growth

The number of cells within an organism increase by mitosis and this is the basis of the development of a multicellular body from a single cell i.e. zygote and also the basis of the growth of multicellular body.

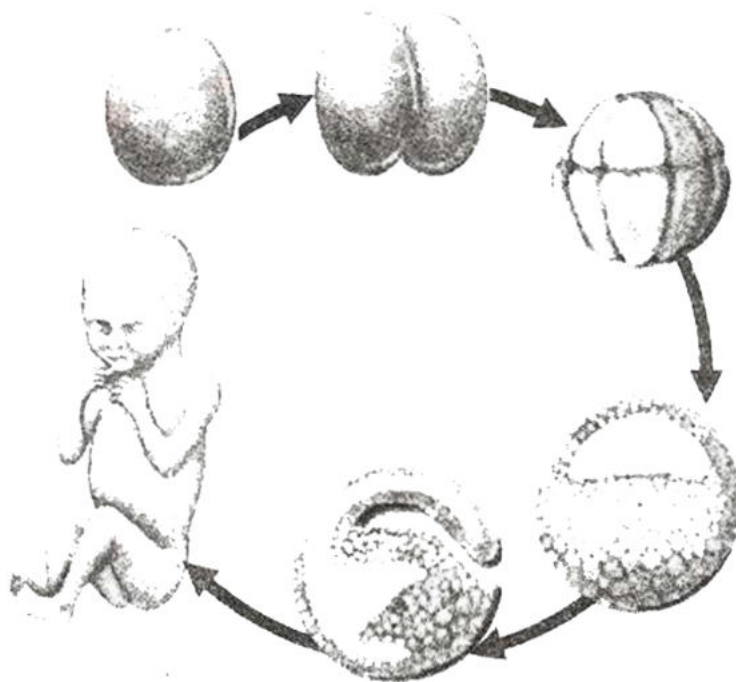



Fig. 5.4: Development of a single cell (Zygote) into a multicellular body

(iii) Cell replacement

Cells are constantly sloughed off, and replaced by new ones in the skin and digestive tract.

(iv) Repairing of damaged tissues

When damaged tissues are repaired, the new cells are formed by mitosis and so are exact copies of the cells being replaced.

Replacement of red blood cells

Red blood cells have short life spans of about 4 months and need to be replaced constantly by mitosis.

(v) REGENERATION

Some organisms can regenerate parts of the body. The production of new cells is achieved by mitosis. For example; sea star regenerates its lost arm through mitosis.

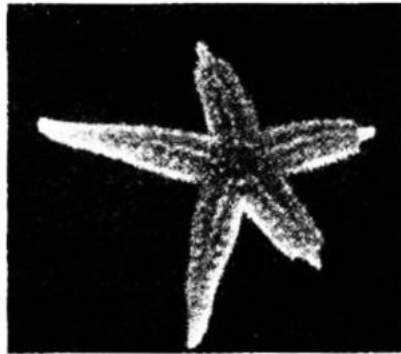
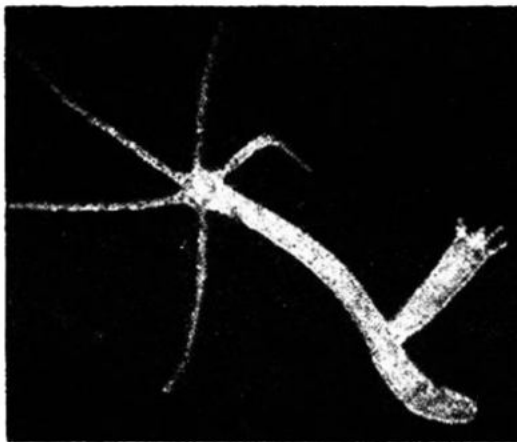



Fig.5.5 Regeneration in sea

(vi) ASEXUAL REPRODUCTION

Some organisms produce genetically similar offspring through asexual reproduction. Mitosis is a mean of asexual reproduction. For example; hydra reproduces asexually by budding. The cells at the surface of hydra undergo mitosis and form a mass called bud. The mitosis continues in the cells of the bud and it grows into a new individual. The same happens during asexual reproduction (vegetative propagation) in plants.

Budding in hydra

Vegetative propagation in plants

Figure 5.6: Asexual reproduction

Q.8. What errors are associated with mitosis?

Ans.

(i) Tumors Formation

Errors in the control of mitosis may cause cancer. All cells have genes that control the timing and number of mitosis. Sometimes mutations occur in such genes and the cells continue to divide. It results in growth of abnormal cells called tumors.

Types

Tumors are of two types.

(i) Benign tumors

As long as the tumors remain in their original location, they are called benign.

(ii) Malignant tumors

If the tumors invade other tissues, they are called malignant (cancerous) and their cells are called cancer cells.

Malignant tumors can send the cancer cells to other parts in the body where new tumors may form. This phenomenon is called **metastasis (spreading of disease).**

Q.9. Define meiosis and explain its phases in detail.

Ans. Definition

"Meiosis is the process by which one diploid eukaryotic cell divides to generate four haploid daughter cells".

Diploid means the cells in which chromosomes are in pairs (homologous pairs) while **haploid** means the cells with half the number of chromosomes i. e. chromosomes are not in the form of pairs.

Meaning of "Word Meiosis"

The word meiosis comes from the Greek word "meioun" meaning "to make smaller" since it results in a reduction in chromosome number.

Discovery of meiosis

Meiosis was discovered and described for the first time in 1876, by a German biologist **Oscar**

Hertwig.

Interphase

The preparatory steps of meiosis are identical to the interphase of mitosis. Interphase is divided into the same three phases i.e. G1, S phase and G2. Interphase is followed by meiosis I and meiosis II.

Meiosis I

In meiosis I, the homologous chromosomes in a diploid cell separate and so two haploid daughter cells are produced. It is the step in meiosis that generates genetic variations. Meiosis I occurs in two main steps i. e. Karyokinesis and Cytokinesis.

Karyokinesis

The division of nucleus in meiosis I is further divided into four phases:

(i) Prophase I **(ii)** Metaphase I

(iii) Anaphase I **(iv)** Telophase I

(i) **Prophase I**

Prophase I is the longest phase in meiosis. It consists of the following steps;

(i) Condensation of chromosomes and formation of tetrad

During this stage, chromatin condenses into chromosomes. The homologous chromosomes line up with each other and form pairs by a process called synapsis. Each pair of homologous chromosomes is said to be **bivalent.** Each bivalent has four chromatids, so it may also be called a tetrad.

(ii) Chiasmata formation during synapsis

The two non sister chromatids of homologous chromosomes join each other at certain points along their length. These points of attachment are called chiasmata.

(iii) Crossing over

In the next stage, the non sister chromatids of homologous chromosomes exchange their segments and the phenomenon is known as crossing over.

The exchange of segments results in the recombination of genetic information. After, crossing over, each pair of homologous chromosomes remain as a bivalent.

Fig: 5.7 Crossing Over

Note: *This phenomenon was observed by an American geneticist Thomas Hunt Morgan in 1911 in fruitfly.Drosophila melanogaster.*

(iv) Other changes during prophase I

(i) Chromosomes condense further.

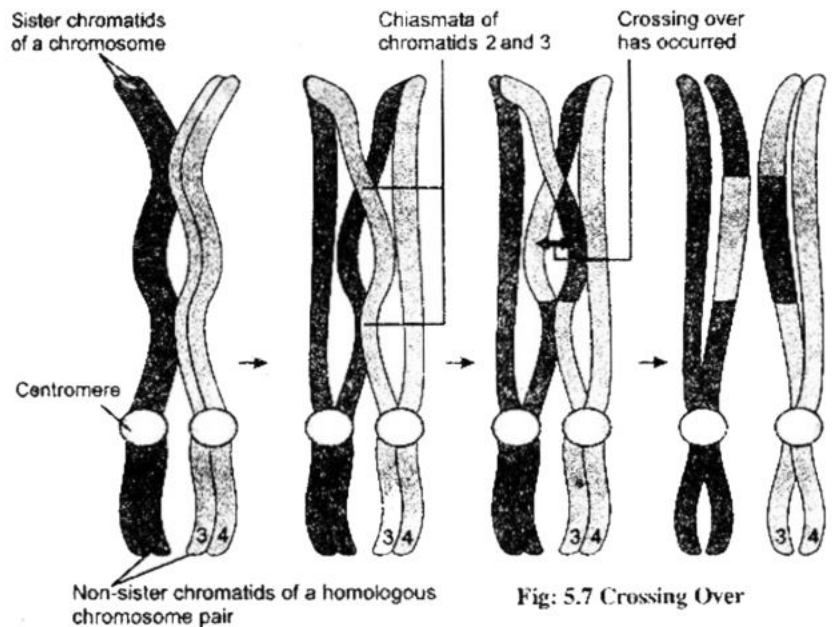
(ii) The nucleoli disappear.

(iii) The nuclear envelope disintegrates.

(iv) Centrioles, which were duplicated during interphase, migrate to the two poles and form spindle fibres.

(v) The kinetochore spindle fibres attach to the kinetochores of chromosomes.

(vi) While the non-kinetochore spindle fibres from both sides interact with each other.

(vii) Two kinetochore spindle fibres attach with a pair of chromosomes.

(ii) Metaphase I

The pairs of homologous chromosomes align along an equatorial plane forming the metaphase plate.

(iii) Anaphase I

Kinetochore spindle fibres shorten. it results in pulling homologous chromosomes apart of each pair. Since, one chromosome (two chromatids) is pulled toward one pole, forming two haploid sets. Each chromosome still contains a pair of sister chromatids.

(iv) Telophase I

The chromosomes arrive at the poles. Each pole now has half the number of chromosomes but each chromosome still consists of a pair of chromatids. The spindle network disappears, and a new nuclear envelope is formed around each haploid set. Chromosomes uncoil back into chromatin.

Fig: 5.8 Stages in Meiosis-1

Cytokinesis

Cytokinesis, the pinching of the cell membrane in animal cells or the formation of the cell wall in plant cells occurs, completing the creation of two haploid daughter cells.

Interkinesis or interphase II

After meiosis I, both haploid daughter cells enter a period of rest known as interkinesis or interphase II. The interphase II is different from the interphase of mitosis and meiosis I. There is no S-phase and so no duplication of chromosomes during this stage.

Meiosis II

It is the second part of the meiotic process. Much of this part is similar to mitosis. It is subdivided into

(i) Prophase II

(ii) Metaphase II

(iii) Anaphase II

(iv) Telophase II

(i) Prophase II

Prophase II takes much less time as compared to prophase I. In this prophase, the nucleoli and the nuclear envelope disappear and the chromatin condenses. Centrioles move to the polar regions and make spindle fibres.

(ii) Metaphase II

In metaphase II, the chromosomes attach with the kinetochore spindle fibres and align at the equator of the cell.

(iii) Anaphase II

In anaphase II, the centromeres are cleaved and sister chromatids are pulled apart. The sister chromatids are now called sister chromosomes and they are pulled towards opposing poles.

(iv) Telophase II

The telophase II is marked with uncoiling of chromosomes into chromatin. Nuclear envelope reforms. Cleavage or cell wall formation eventually produces a total of 4 daughter cells, each with a haploid set of chromosomes.

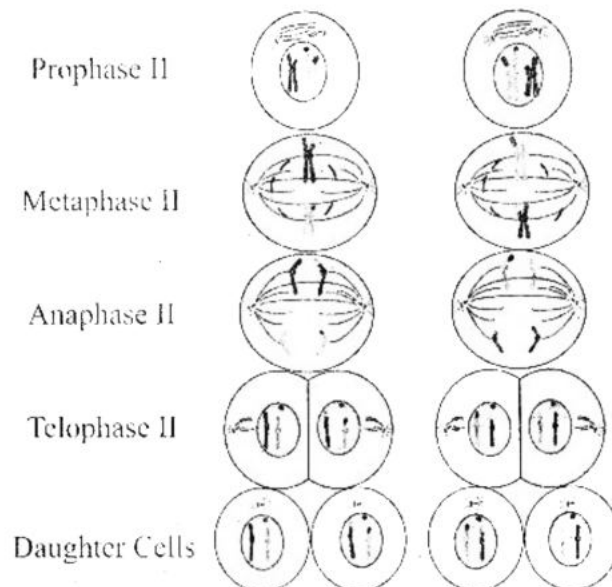



Figure 5.9: Stages in Meiosis-II

Q.10. Describe significance of meiosis?

Ans. Introduction

The significance of meiosis for reproduction and inheritance was described in 1980 by German biologist August Weismann.

(i) Maintenance of chromosome number

August Weismann noted that meiosis was necessary not only to maintain the number of chromosomes in the next generation but also to produce variations in next generation.

(ii) Meiosis for sexual reproduction of eukaryotes

Meiosis is essential for sexual reproduction and therefore occurs in all eukaryotes including single celled organisms that reproduce sexually. Meiosis does not occur in prokaryotes, which reproduce asexually by binary fission.

(iii) Meiosis in humans

In human diploid gametes, mother cells or germ line cells undergo meiosis to produce haploid gametes. Male and female gametes unite to form diploid zygote which undergoes repeated mitosis and develops into the new diploid human.

(iv) Gamete formation in fungi and protozoa

Many haploid fungi and protozoa produce haploid gametes through mitosis.

(v) Meiosis in plants

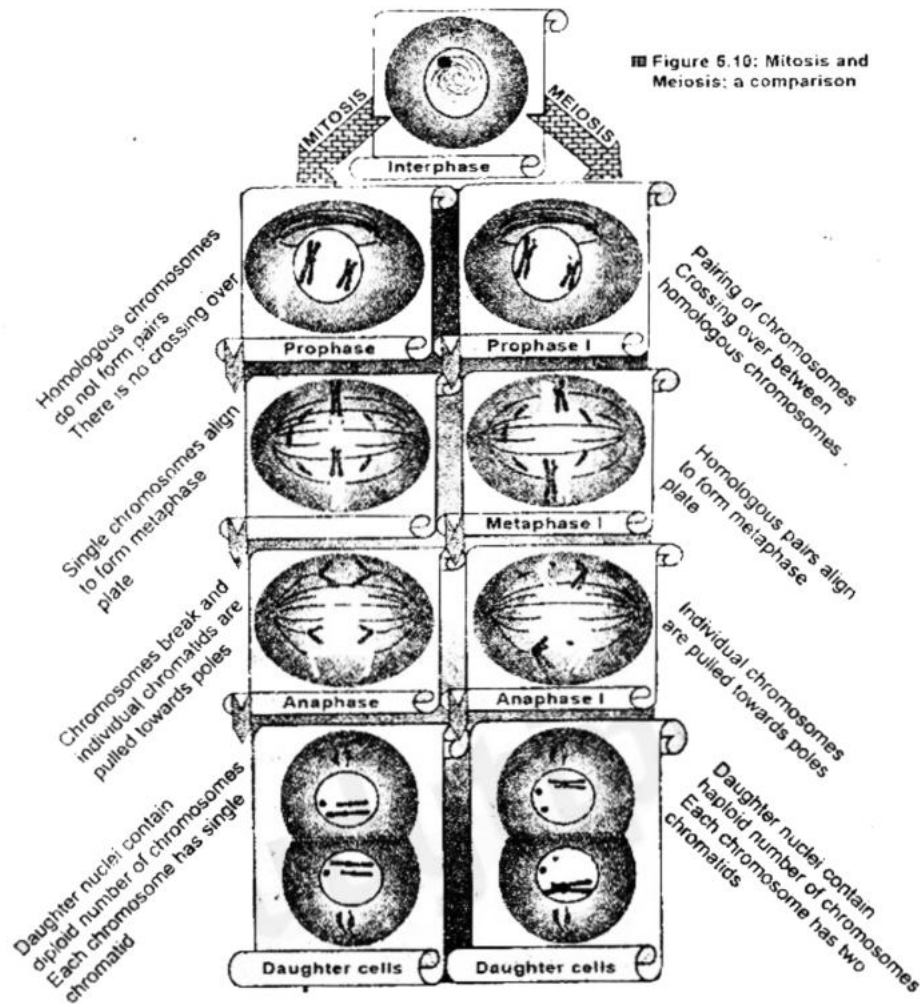
Plants' life cycle shows alternation of generation. The cells of the diploid sporophyte generation undergo meiosis to produce haploid spores, which grow into haploid gametophyte generation. The haploid gametophyte generation produces haploid gametes through mitosis. The gametes combine to produce the diploid zygote. The zygote undergoes mitosis to become the diploid sporophyte.

(vi) Meiosis as a source of genetic variations

The chromosome pairs of each parent undergo crossing over during meiosis. So daughter cells i.e. gametes have genetic variations. When gametes fuse and form zygote; its genetic make up is different from both parents. Thus meiosis allows a species to bring variations which help organisms to adapt to the changes in environment.

Q.11. What are common errors of meiosis?

Ans. The normal separation of chromosomes or sister chromatids in meiosis is termed as **disjunction**. When the separation is not normal, it is called non **disjunction.** This result in the production of gametes which have either more or less than the usual number of chromosomes. Such Individuals have 45 or 47 chromosomes in humans.

Q.12. Describe comparison between mitosis and meiosis (Lahore board 2012 G I)

Q.13. What is apoptosis? What happens in it? Describe its importance. (Lahore board 2011 G I)

Ans. Programmed cell death

"Between 50 billion to 70 billion cells die each day due to apoptosis in an adult human". Apoptosis is one of the main types of programmed cell death.

Events of apoptosis

Following is the series of events in apoptosis:

(i) Cell shrinks and becomes rounded due to the breakdown of the cytoskeleton by enzymes.

(ii) Chromatin undergoes condensation and the nuclear envelope breaks.

(iii) In this way, nucleus spreads in the form of several discrete chromatin bodies.

(iv) The cell membrane makes irregular buds known as **blebs**.

(v) The blebs break off from the cell and are now called apoptotic bodies, which are then phagocytosed by other cells.

Causes of apoptosis

Apoptosis can occur when a cell is damaged, or undergoes stress conditions.

Significance of apoptosis (Lahore board 2011 G I) (short question)

(i) Removal of damaged cell

Apoptosis removes the damaged cell, preventing it from getting further nutrients or to prevent the spread of infection.

(ii) Differentiation of fingers and toes in embryo

Apoptosis generally gives advantages during development. For example, during the formation of fingers, the cells between them undergo apoptosis and the digits separate.

Q.14. Write a note on necrosis. (Lahore board 2011 GI & 2012 G II) (short question)

Ans. Accidental cell and tissue death

Necrosis is the accidental death of cells and living tissues, necrosis is less sequential than apoptosis.

Causes of necrosis

There are many causes of necrosis including injury, infection, cancer. Necrosis may occur when a cell is given hypoxic (with less oxygen) environments. Spider bites also cause necrosis in some areas. It may be due to lack of proper care to a wound site.

Control of necrosis

Necrosis is accompanied by the release of special enzymes from the lysosomes. The lysosomal enzymes break cellular components and may also be released outside the cell to break surrounding cells. Cells that die by necrosis may release harmful chemicals that damage other cells.

Multiple Choice Questions

1. In which stage of the cell cycle each chromosome is duplicated and so it consists of two chromatids?
   (a) G1 (b) S
   (c) M (d) G2
2. During which phase of mitosis spindles are formed?
   (a) G2 (b) Interphase
   (c) Prophase (d) Metaphase
3. In which stage of the cell cycle, the cell is preparing enzyme for chromosome replication?
   (a) G1 (b) G2
   (c) S (d) M
4. Which of the following stage of cell division is very different for animal and plant cells ?
   (a) Telophase (b) Metaphase
   (c) Anaphase (d) Cytokinesis
5. Prior to cell division, each chromosome replicates or duplicates its genetic material, the products are connected by a centromere and are called;
   (a) Sister chromosomes
   (b) Homologous chromosomes
   (c) Non-sister chromatids
   (d) Sister chromatids
6. The process of mitosis ensures that:

(a) Each new cell is genetically different from its parent.

(b) Each new cell receives the proper number of chromosomes.

(c) Cells will divide at the appropriate time

(d) Chromosomes replicate without errors.

7. Cytokinesis in a plant cell is characterized by;

(a) The equal division of homologous chromosomes.

(b) A pinching off of the cell membrane to divide the cell.

(c) The formation of a cell plate in the cytoplasm

(d) The movement of the chromosomes from the metaphase plate.

8. Which of the following is unique to mitosis and not a part of meiosis?

(a) Homologous chromosomes pair forming bivalents.

(b) Homologous chromosomes cross over.

(c) Chromosome pairs are broken during anaphase

(d) Chromatids separate during anaphase

9. Which event distinguishes meiosis from mitosis?

(a) Condensation of chromosomes

(b) Loss of the nuclear membrane

(c) Formation of metaphase plate.

(d) Pairing of homologous chromosomes.

10. In which stage of the cell cycle most cells spend their lives?

(a) Prophase (b) Metaphase

(c) Interphase (d) Telophase

11. Which of the following distinguishes meiosis from mitosis?

(a) The chromosome number is reduced.

(b)Chromosomes undergo crossing over.

(c) Daughter cells are genetically different from the parent cell.

(d) All of the above.

12. For mitosis, the chromosomes of the cells is duplicated during interphase. When do the chromosomes duplicated for meiosis?

(a) Before meiosis I

(b) Before meiosis II

(c) During Meiosis-I

(d) Do not duplicate

13. Find the correct statement.

(a) Homologous chromosomes form pairs during mitosis.

(b) Chromosomes do not duplicate in the interphase preceding meiosis-I.

(c) Homologous chromosomes form pairs during meiosis but not mitosis.

(d) Spindles are not required during meiosis.

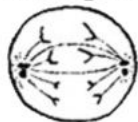
14. What reason would you suggest for the fact that the total DNA content of each daughter cell is reduced during meiosis?

(a) Chromosomes do not replicate during the interphase before meiosis I.

(b) Chromosomes do not duplicate between meiosis I and II.

(c) Half of the chromosomes from each gamete are broken.

(d) Sister chromatids separate during anaphase of meiosis I.

15. If you observe a cell like this one, what phase of mitosis is it?

(a) Anaphase (b) Telophase
(c) Metaphase (d) Prophase

16. Specific enzymes are synthesized by:
(a) G_0 (b) G_2
(c) S phase (d) G_1

17. The phase which can exist for life is:
(a) G_0 (b) G_2
(c) S phase (d) G_1

18. Chromosomes become double during:
(a) G_2 (b) G_0
(c) G_1 (d) S phase

19. The longest phase is:
(a) Mitotic phase (b) Meiosis
(c) Cell cycle (d) Interphase

20. Type of spindle fibre which attaches the chromosomes is called:
(a) Kinetochore (b)Non kinetochore
(c)Both a and b (d) Centromere

21. The chromosomes are attached in the equator of spindle in:
(a) Prophase (b) Telophase
(c) Anaphase (d) Metaphase

22. Chromatids get separated from each other during:
(a) Telophase (b) Prophase
(c) Anaphase (d) Metaphase

23. Chromatids are condensed during:
(a) Anaphase (b) Telophase
(c) Prophase (d) Metaphase

24. Uncoiling of chromosomes take place during:
(a) Prophase (b) Telophase
(c) Anaphase (d) Metaphase

25. The division of nucleus is:
(a) Mitosis (b) Karyokinesis
(c) Cytokinesis (d) Meiosis

26. Chromosomes are not visible during:
(a) Prophase (b) Interphase
(c) Anaphase (d) Metaphase

27. The condensation of chromosomes is completed during:
(a) Telophase (b) Prophase
(c) Anaphase (d) Metaphase

28. Cytokinesis in animals take place by
(a) Furrow (b) Phragmoplast
(c) Telophase (d) None of the above

29. Which of the following structure is absent in animals?
(a) spindle (b) centrioles
(c) Chromatids (d) Phragmoplast

30. Cells of which of the followings are called cancer cells?
(a) Malignant tumor (b)Benign tumor
(c) both a and b (d) None of the above

31. Which of the followings stage is similar in mitosis and meiosis ?
(a) Prophase (b) Anaphase
(c) Metaphase (d) Telophase

32. The exchange of part of chromatids is:
(a) Chiasmata (b) Linkage
(c) crossing over
(d) None of the above

33. The cell death due to tissue damage is:
(a)Apoptosis (b) Necrosis
(c) Metastasis (d) Synapsis

34. Necrosis is:
(a) Division of cells
(b) Suicide of cells
(c) Cell death by tissue damage
(d) Weakness of cells

35. Meiosis discovered in: (Lahore board 2011 G II)
(a) 1876 (b) 1879
(d) 1960 (d) 1850

36. Hydra reproduces asexually by:

(a) Cutting (b) Grafting
(c) Budding (d) Binary fission

(Lahore board 2011 G I)

37. In which phase, cell increases the number of its many organelles and grows in size:

(a) G1 (b) S phase
(c) G2 (d) G0

(Lahore board 2011 G I)

Answers

1.	b	11.	d	21.	d	**31.**	**d**	
2.	c	12.	a	22.	c	**32.**	**c**	
3.	a	13.	c	23.	c	**33.**	**b**	
4.	d	14.	b	24.	b	**34.**	**c**	
5.	d	15.	a	25.	b	**35**	**a**	
6.	b	16.	d	26.	b	**36**	**c**	
7.	c	17.	a	27.	b	**37**	**a**	
8.	d	18.	d	28.	a			
9.	d	19.	d	29.	d			
10	c	20.	a	30.	A			

Short Questions

Q.1. What is Anaphase?

Ans. 1. In this phase, the homologous parts of the chromosomes are separated from each other.

2. The spindle fibres are contracted.
3. The chromosomes start to move towards the opposite poles.
4. Anaphase I is different from anaphase of mitosis because half of the number of chromosomes move towards each pole and each chromosome still has two chromatids.

Q.2. Define Apoptosis. (Lahore board 2011 G II)

Ans. 1. Apoptosis is the main type of programmed cell death.

2. It involves a series of biochemical events.
3. Between 50-70 billion cells die each day due to apoptosis in an adult human.

Q.3. What is Benign? (Lahore board 2011 G I)

Ans. Some time mutations occur in genes that control the timing and number of mitosis and the cells continue to divide. It results in growth of abnormal cells called tumors. As long as these tumors remain in their original location, they are called benign.

Q.4. What is Go Phase?

Ans. In multicellular eukaryotes, cells enter the Go phase from G1 and stop dividing. Cells that have temporarily or permanently stopped dividing are said to have entered a state of quiescence, called G0 phase. Some cells remain quiescence for long periods of time. e.g. neurons. Some cells enter Go phase semi – permanently e.g., some cells of liver and kidneys. Many cells do not enter Go and continue to divide throughout an organism's life. e.g. epithelial cells.

Q.5. What is Budding?

Ans. Budding is the type of asexual reproduction in which an outgrowth is formed which is ultimately separated and grows in size e.g; yeast (Fungi)

Q.6. Define Crossing Over.

Ans. During meiosis prophase 1, the exchange of genetic material takes place between homologous chromosomes is called crossing over.

Q.7. What is G1 Phase? (Lahore board 2012 G II) (Lahore board 2012 G I)

Ans. (Cell cycle starts from G1)

1. Cell increases its supply of proteins.
2. Increases the number of organelles (such that mitochondria, ribosomes)
3. Cell grows in size.

Q.8. What is G2 Phase?

Ans. In the G2 phase, the cell prepares proteins that are essentieal for mitosis, mainly for the spindle fibres.

Q.9. Define Homologous Chromosomes.

Ans. The chromosomes which are similar in morphology (size, structure and position of centromere) is known as homologous chromosomes.

Q.10. What is Interphase?

Ans. Interphase is the major phase of the cell cycle. It is the time when cell's metabollic activity is very high and it performs various functions. Typically interphase lasts for at least 90% of the total time required for cell cycle.

It is divided into three phases:

1. G1(First gap)
2. S phase (Synthesis)
3. G2(Second gap)

Q.11. Define Karyokinesis.

Ans. The division of nucleus is known as karyokinesis. The division of nucleus is further sub-divided into 4 phases.

1. Prophase 2. Metaphase 3. Anaphase 4. Telophase

Q.12. Define Mitosis: (Lahore board 2012 G II)

Ans. The type of cell division in which two daughter cells are formed and number of chromosomes remain same as that of parents cells:

Q.13. What is Kinetochore?

Ans. Each chromosome has kinetochore at centromere. A kinetochore is a complex protein structure that is the point where spindle fibres attach.

Q.14. What is M-Phase?

Ans. After the G2 phase of interphase, the cell enters the division phase i.e. M-Phase. It is characterized by mitosis, in which the cell divides into two daughter cells and the number of chromosomes remain same as that of parent cell.

Q.15. Define Malignant. (Lahore board 2011 G I)

Ans. Some time mutations occur in genes that control the timing and number of mitosis and the cell continue to divide. It results in growth of abnormal cells called tumors. If these tumors invade other tissues, they are called malignant (cancerous) tumars and their cells are called cancer cells.

Q.16. What is Metaphase?

Ans. When the spindle grows to sufficient length, some of the spindle fibres, known as kinetochore fibres, begin searching for kinetochores to attach. A number of other fibres (non kinetochore) interact with the corresponding fibres from the opposite centrosome.

Q.17. What is Metaphase plate?

Ans. During metaphase, a kinetochore fibre attaches to kinetochores of the centromeres of the chromosomes arrange themselves along the equater of the cell forming a metaphase plate.

Q.18. What is Cell cycle?

Ans. The cell cycle is the series of events from the time a cell is produced until it completes mitosis and produces new cell.

The cell cycle consists of two major phase.

1. Interphase
2. Mitotic phase

Q.19. What is Chiasmata?

Ans. Chiasmata is the region where crossing over occurs. It is a cross like links between two homologous chromosomes. After crossing over, homologous chromosomes separate from one another but remain tightly packed at chiasmata.

Q.20. Define Necrosis.

Ans. Necrosis is the name given to accidental death of cells and living tissue. There are many causes of necrosis such as:

1. Injury
2. Infection

Necrosis is accompanied by special enzymes from lysosomes.

Cells that die from necrosis may also release harmful chemical that damage other cells.

Q.21. Define prophase.

Ans. Following changes takes place during prophase of mitotic division:

(i) Condensation of chromatin
(ii) Duplication of chromosomes
(iii) Formation of mitotic spindle
(iv) Disappearance of nucleolus
(v) And nuclear envelope

Q.22. Define Phragmoplast.

Ans. During cytokinesis in plants, the vesicles derived from the Golgi apparatus move to the middle of the cell and fuse to form a membrane-bounded disc called the cell plate or phragmoplast.

Q.23. What is S-Phase:

Ans. In this phase, the cell duplicates its chromosomes. The DNA molecules of each chromosome is copied, and new protein molecules are attached.

Q.24. What are Sister chromatids?

Ans. The two chromatids of same chromosome are called sister chromatids. They are attached at same centromere.

Q.25. Define Spindle.

Ans. The two centrosomes give rise to microtubules by polymerizing the tubulin proteins present in the cytoplasm. The microtubules thus formed are called spindle fibres and the complete set of the spindle fibres is known as mitotic spindle.

Q.26. What is Synapsis?

Ans. During meiosis prophase 1, the lengthwise pairing of homologous chromosomes is called synapses

Or

The two non-sister chromatids of chromosomes become "zipped" together, forming complexes known as chiasmata, in a process known as synapsis.

Q.27. Define Tubulin.

Ans. Tubulin is a type of protein present in the cytoplasm. The tubulin monomers give rise to microtubules by polymerization.

Q.28. What is Tumor?

Ans. Errors in the control of mitosis may cause cancer. All cells have genes that control the timing and number of mitosis. Sometimes mutations occur in such genes and cells continue to divide. It results in growth of abnormal cells called tumors.

Q.29. Define Metastasis.

Ans. The tumors can send the cancer cells to the other parts in the body where new tumor may form. This phenomenon is called metastasis.

Q.30. What are different phases of mitosis?

Ans. Phases:

Mitosis has four phases:

1. Prophase 2. Metaphase 3. Anaphase 4. Telophase

Q.31. Define Cytokinesis?

Ans. Cytokinesis is the division of cytoplasm.

Q.32. How cytokinesis takes place in animal cells.

Ans.

1. It occurs by a process known as cleavage.
2. A cleavage furrow develops where the metaphase plate (a part of the cytoskeleton) used to be.
3. The ring contracts deepening the furrow and eventually pinching the parent cell into two.

Q.33. How cytokinesis takes place in plant cell.

Ans.

1. In plant cells it occurs differently.
2. Vesicles derived from the Golgi apparatus move to the middle of the cell and fuse to form a membrane- bounded disc called the cell plate or phragmoplast.
3. The plate grows outward and more vesicle fuse with it. Finally the membranes of the cell plate fuse with the plasma membrane and its contents join the parent cell wall.

Q.34. What is meiosis? (Lahore board 2012 G II)

Ans. Meiosis is the process by which one diploid eukaryotic cell divides to generate four haploid daughter cells. Diploid means the cell in which chromosomes are in pairs (homologous pairs) while haploid means the cells with half the number of chromosomes i.e. chromosomes are not in the form of pairs.

Q.35. Define crossing over? (Lahore board 2011 G II)

Ans. During meiosis prophase 1, the non sister chromatids of homologous chromosomes randomly exchange their segments and this phenomenon is called crossing over.

Q.36. Write Significance of Meiosis.

Ans.

1. Number of chromosomes remains constant in species to species.
2. Variations are produced.
3. Resistance power is produced due to meiosis.
4. Meiosis takes place in gamete formation and spore formation.
5. Each zygote will have a unique genetic make up.

Unit 06

ENZYMES

Q.1. Describe metabolism and its types. What is role of enzymes in metabolism?

Ans.

Definition

Metabolism is the set of biochemical reactions that occur in living organisms in order to maintain life.

Explanation of term 'Metabolism'

The term metabolism is derived from a Greek word meaning "change". The concept of metabolism was first of all given by **Ibn-e-Nafees**, who stated that "the body and its parts are always undergoing change"

Importance

These processes allow organisms to grow and reproduce, maintain their structures and respond to their environments. Biochemical reactions in living organisms are essentially energy transfers.

Types

It is of two types

(i) Anabolism

Anabolism includes the biochemical reactions in which larger molecules are synthesized. e.g., Photosynthesis and assimilation. Energy is utilized in anabolism.

Catabolism

Catabolism includes the biochemical reactions in which larger molecules are broken down. e.g., respiration and digestion of food. Energy is released in catabolism

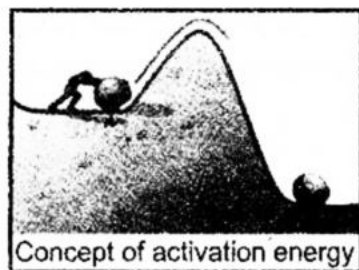
Role of Enzymes during Metabolism

During metabolism, chemicals are transformed from one form to the other by enzymes. Enzymes are crucial to metabolism because they act as biocatalysts and speed up and regulate the metabolic pathways.

Q.2. Define enzymes. Explain enzymatic action.

Ans. Enzymes

Enzymes are proteins that catalyze (i.e. speed up) biochemical reactions and are not changed during the reaction.

Concept of activation energy

Explanation

(i) Substrate

In enzymatic reactions, the molecules at which enzymes act are called substrates.

(ii) Products:

The enzymes convert substrate into different molecules, the products.

(iii) Activation energy:

All chemical reactions require activation energy. It is defined as minimum energy required to start a reaction. The need for activation energy acts as a barrier to the beginning of reaction (as symbolized in the diagram). Enzymes lower such barriers by decreasing the requirement of activation energy. Thus, in the presence of enzymes, reactions proceed at a faster rate.

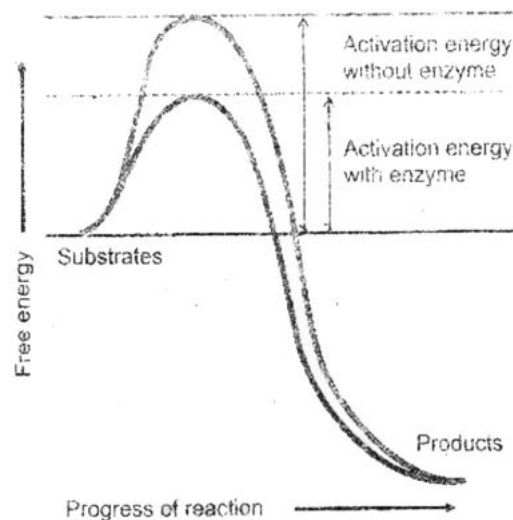



Figure 6.1: Enzymes lower the activation energy

Ways of lowering activation energy

Enzymes lower the activation energy in several ways. They do so by;

(i) Altering the shape of the substrate and reducing the requirement of energy for this change.

(ii) Disrupting the charge distribution on substrates

(iii) Bringing substrates in the correct orientation to react.

Q.3. Describe characteristics of Enzymes.

Ans. Introduction

In 1878, German physiologist Winhelm Kuhne first used the term enzyme. Enzymes are globular proteins and are made of long, linear chains of amino acids that fold to produce a three dimensional molecule.

Characteristics of Enzymes in nature

(i) All enzymes are protein

Almost all enzymes are proteins i.e. they are made of amino acids.

(ii) Increase the rate of reaction

The most enzymes reaction rates are millions of times faster than those of comparable uncatalysed reactions.

(iii) Not consumed by reaction

As with all catalysts, enzymes are not consumed by the reactions they catalyze.

(iv) Enzymes are specific

Enzymes are usually very specific for the type of reaction and for the nature of their substrates.

(v) Active sites

Only a small portion of enzyme molecule is directly involved in catalysis. This catalytic region is known as active site. It recognizes and binds substrate, and then carries out the reaction.

(vi) Enzymes activity can be regulated

Enzyme production can be enhanced or diminished by a cell according to needs. Enzyme activity can also be regulated by inhibitors and activators.

(vii) Cofactors

Some enzymes do not need any additional component to work. However, others require non protein molecules or ions called cofactors.

Cofactors can be either inorganic (e.g. metal ions) or organic (e.g. flavin and heme).

a) Prosthetic groups

If organic cofactors are tightly bound to enzyme, they are called prosthetic groups.

b) Co-enzymes

If organic co-factors are loosely attached with enzyme, they are called co-enzymes.

Co-enzymes transport chemical groups from one enzyme to another. Some important co-enzymes are vitamins (e.g. riboflavin, thiamine and folic acid).

(viii) Enzymes can work together in a specific order

Several enzymes can work together in a specific order, creating metabolic pathways. In a metabolic pathway, one enzyme takes the product of another enzyme as a substrate. After the reaction, the product is then passed on to the next enzyme.

Uses of enzymes **(Lahore board 2012 G II)**

Enzymes are extensively used in different industries for fast chemical reactions. For example

i) Food Industry

Enzymes that break starch into simple sugars are used in the production of white bread, buns etc.

ii) Brewing industry

Enzymes break starch and proteins. The products are used by yeast for fermentation (to produce alcohol).

iii) Paper Industry **(Lahore board 2012 G I)**

Enzymes break starch to lower its viscosity that aids in making paper.

iv) Biological detergent **(Lahore board 2011 G I) (short question)**

Protease enzymes are used for the removal of protein stains from clothes. Amylase enzymes are used in dish washing to remove resistant starch residues.

Q.4. Describe factors affecting the rate of enzyme action.

Ans. Enzymes are very sensitive to the environment in which they work. The activity of an enzyme is affected by any change in conditions that alters its chemistry and its shape. Some of the factors that can affect the rate of enzyme action are being discussed below:

1. Temperature: **(Lahore board 2011 G I)**

Increase in temperature speeds up the rate of enzyme catalyzed reactions, but only to a point.

Optimum temperature:

Every enzyme works at its maximum rate at a specific temperature called as the optimum temperature for that enzyme. when temperature rises to a certain limit, the heat adds in the activation energy and also provides kinetic energy and so reactions are accelerated.

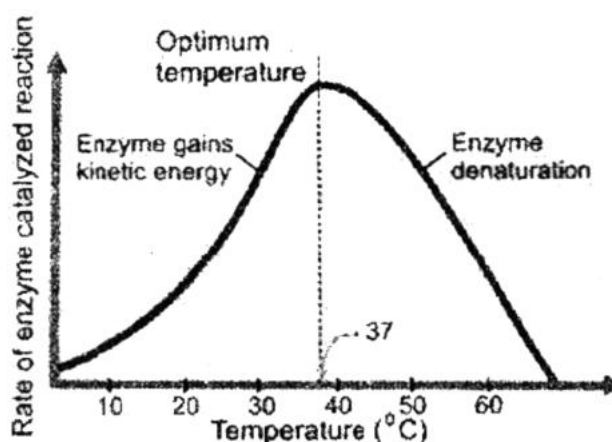



Figure 6.2: Effect of temperature on enzyme activity

Denaturation of enzyme:

When temperature is raised well above the optimum temperature, the heat energy increases the vibrations of atoms of enzyme and the globular structure of enzyme is lost. This is known as denaturation of enzyme.

It results in a rapid decrease in the rate of enzyme action and it may be blocked completely.

2. Substrate Concentration:

If there are enzyme molecules with vacant active sites, an increase in substrate concentration will increase the rate of reaction.

Saturation of active sites:

If the enzyme concentration is kept constant and the amount of substrate is increased, a point is reached where any

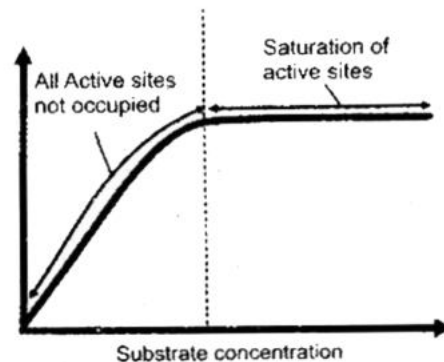



Fig: 6.3 Effect of Substrate on Enzyme Activity

further increase in substrate does not increase the rate of reaction any more. When all the active sites of the enzymes are occupied (at high substrate concentration), any more substrate molecules do not find free active sites. This state is called saturation of active sites and reaction rate does not increase.

3. pH (Optimum pH):

All enzymes work at their maximum rate at a narrow range of pH, called as the optimum pH. A slight change (increase or decrease) in this pH causes retardation in enzyme activity or blocks it completely.

Every enzyme has its specific optimum pH value. For example

Pepsin (working in stomach) is active in acidic medium (low pH).

Trypsin (working in small intestine) shows its activity in alkaline medium (high pH).

Figure 6.4: Effect of pH on enzyme activity

Change in pH can effect the ionization of the amino acids at the active sites.

Q.5. Describe the mechanism of enzyme action.

Ans. Mechanism of enzyme action E + S ⟶ ES Complex ⟶ E + P

When enzyme attachés with the substrate, a temporary enzyme-substrate (ES) complex is formed. The enzyme catalyzes the reaction and substrate is transformed into product. The ES complex breaks enzyme and products are released.

Figure 6.5: Lock and key model of enzyme action

Lock and key model:

In order to explain the mechanism of enzyme action, a German chemist Emil Fischer, in 1894 proposed the lock and key model. According to this model, both enzyme and the substrate possess specific shapes that fit exactly into one another. This model explains enzyme specificity.

Induced fit model:

The induced fit model is more acceptable than the lock & key model. In 1958, an American biologist Daniel Koshland suggested a modification to the lock and key model and proposed the induced fit model. According to this model, active site is not a rigid

Figure 6.6: Induced fit model of enzyme action

structure rather it is molded into the required shape to perform its function.

Q.6. Describe the specificity of enzymes. **(Lahore board 2012 G I)**

Ans. No. of known enzymes

There are over 2000 known enzymes, each of which is involved in one specific chemical reaction. Enzymes are also substrate specific.

Examples of enzymes specificity

The enzyme protease (which breaks peptide bonds in proteins) will not work on starch (which is broken down by an enzyme amylase). Similarly lipase enzyme acts only on lipids and digests them into fatty acids and glycerol.

Determination of specificity of enzymes

The specificity of different enzymes is determined by the shapes of their active sites. The active sites possess specific geometric shapes that fit with specific substrates. See in fig. 6.7 how the geometric shape of the active site of the given enzyme determines its specificity for substrate

(point out which substrate can exactly fit in the active site).

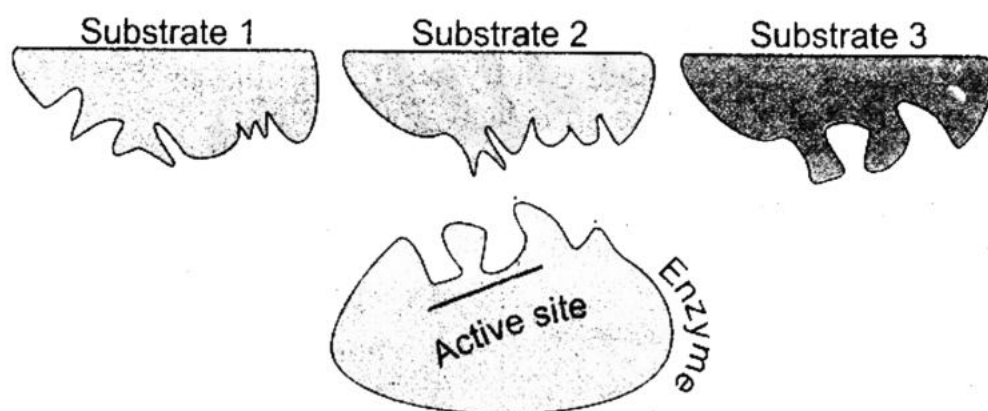



Figure 6.7: Specificity of enzymes due to geometric shape of active site

Multiple Choice Questions

1. What is TRUE about enzymes?
   (a) They make biochemical reactions to proceed spontaneously
   (b) They lower the activation energy of a reaction
   (c) They are not very specific in their choice of substrates
   (d) They are needed in large quantities

2. To what category of molecules do enzymes belong?
   (a) Carbohydrates (b) Lipids
   (c) Nucleic acids (d) Proteins
   (Lahore board 2011 G I)

3. What is true about cofactors?
   a) Break hydrogen bonds in proteins
   b) Help facilitate enzyme activity
   c) Increase activation energy

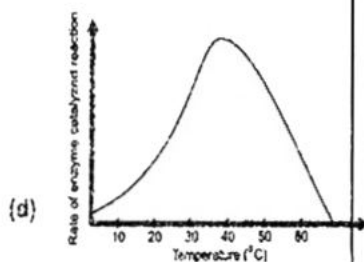
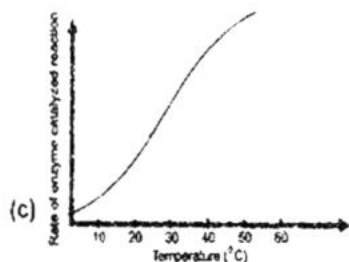
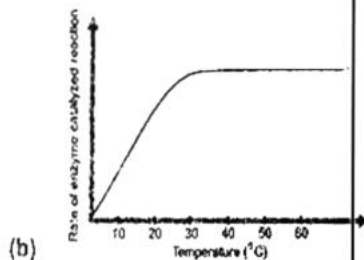
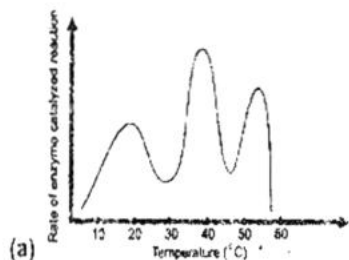
d) Are composed of proteins

4. Prosthetic groups are;

(a) Required by all enzymes
(b) Loosely attached with enzymes
(c) Proteins in nature
(d) Tightly bound to enzyme

5. When we add more substrate to an already occurring enzymatic reaction and there is no increase in the rate of reaction, what would you predict?

(a) All active sites have been occupied by substrate molecules
(b) The enzyme molecules have denatured
(c) More substrate acted as inhibitor
(d) More substrate has disturbed the pH of the medium

6. Which of these graphs correctly shows the effect of temperature on the rate of an enzyme-controlled reaction?

7. The substance on which an enzyme act is called :

(a) Cofactor (b) Inhibitor
(c) Coenzyme (d) Substrate

8. Non- protein part of enzymes are:

(a) Inhibitors (b) Substrate
(c) Cofactors (d) Coenzymes

9. Optimum temperature for enzymes of human body is:

(a) 86°C (b) 37°C
(c) 38°C (d) 39°C

10. Activation energy is required to:

(a) activate enzyme
(b) start a reaction
(c) speed up a reaction (d) None

11. Lock and key Model was proposed by:

(a) Emil Fischer (b) Melcher
(c) Koshland (d) Saugeo

12. Induced Fit model was proposed by:

(a) Emil Fischer (b) Koshaland
(c) Meicher (d) Saqr

13. Which enzyme breaks the peptide bonds:

a) Amylase (b) Protease
(c) Lipase (d) None

14. Which enzyme converts lipids into fattyacid and glycerol?

(a) Lipase (b) Amylase
(c) Pepsin (d) Trypsin

15. Number of discovered enzymes are :

(a) 200 (b) 2000
(c) 3000 (d) 3500

(Lahore board 2011 G II)

Answers

1.	b	6.	D	11.	a
2.	d	7.	D	12.	b
3.	b	8.	C	13.	b
4.	d	9.	B	14.	a
5.	a	10	B	15.	b

Short Questions

Q:1. Define Activation energy.
Ans. The amount of energy required by all chemical reactions to break chemical bonds and begin the reaction.

Q:2. What are Active sites? **(Lahore board 2011 G II)**
Ans. The small portion of enzyme which take part in a chemical reaction is known as active site.

Q:3. On what substrate Amylase act?
Ans. Amylase is an enzyme which act on starch and convert it into maltose.

Q:4. Define Anabolism. **(Lahore board 2011 G I)**
Ans. Anabolism is the total series of chemical reactions involved in the synthesis of compounds. e.g. Photosynthesis and assimilation.

Q:5. What are Biocatalysts?
Ans. Enzymes are known as biocatalyst because they speed up and regulate the metabolic pathway in living organisms.

Q:6. Define Catabolism. **(Lahore board 2011 G I)**
Ans. Catabolism is the series of chemical reactions in which complex or large molecules are broken down e.g. Respiration and digestion.

Q:7. Define Catalysts.
Ans. These are the chemical substances which speed up a chemical reaction. e.g. Nickel is used as catalyst during hydrogenation of palm oil into banaspati ghee.

Q:8. Define Co-enzymes.
Ans. If organic co-factors are loosely attached with enzyme they are called co-enzymes. Some important vitamins e.g., riboflavin, thiamine and folic acid act as coenzymes.

Q:9. Define Co-factors.
Ans. Some enzymes require non protein molecules or ions to show full activity, these molecules or ions are called cofactors. Cofactors can be either inorganic e.g. metal ions or organic e.g., flavin and heme.

Q:10. What is Denaturation of an enzyme?

Ans. When temperature is raised well above the optimum temperature, the heat energy increases the vibrations of atoms of enzyme molecules and the globular structure of enzyme is lost. This is known as denaturation of enzyme.

Q:11. What is Optimum pH?

Ans. All enzymes work at their maximum rate at a narrow range of pH, called as the optimum pH e.g., pepsin is active in acidic medium (low pH).

Q:12. What is Optimum Temperature?

Ans. Every enzyme works at its maximum rate at a specific temperature called as the optimum temperature for that enzyme e.g., optimum temperature for the maximum working speed of human enzymes is $37^{o}C$.

Q:13. Define Enzymes.

Ans. Enzymes are proteins that catalyze (i-e speed up) biochemical reaction and are not changed during the reaction.

Q:14. What is Enzyme Substrate Complex?

Ans. When enzyme attaches with the substrate, a temporary enzyme substrate complex (ES) is formed. The enzyme catalyzes the reaction, substrate is transformed into product, the (ES) complex breaks and enzyme product are released.

Q:15. Define Lipase. Enzyme acts on which components?

Ans. Lipase is the enzyme which acts on lipids and digests them into fatty acids and glycerol.

Q:16. Describe Lock and key model. **(Lahore board 2012 G II)**

Ans. In order to explain the mechanism of enzyme action, a German Chemist Emil Fischer, in 1894 proposed the lock and Key model. According to this model both the enzyme and the substrate possess specific complementary geometric shapes, that fit exactly into one another. This model explains enzyme specificity.

Q:17. Define Metabolism. **(Lahore board 2012 G I)**

Ans. Metabolism is the set of biochemical reactions that occur in living organisms in order to maintain life. It is of two types: Anabolism and Catabolsim.

Q:18. What do you know about the product of the reaction?

Ans. The molecules at which enzymes act are called substrates, and enzymes converts them into different molecules, called products.

Q:19. What do you mean by Saturation of active sites?

Ans. When all the active sites of the enzymes are occupied (at high substrate) any more substrate molecule do not find free active sites, this state is called saturation of active sites and the reactions rate does not increase.

Q:20. What are Substrates?

Ans. In enzymatic reactions, the molecules at the beginning of the process are called substrate.

Q:21. What is Prosthetic Group?

Ans. If organic cofactors are tightly bound to enzyme, they are called prosthetic group.

Q:22. Describe Induced fit model.

Ans. The induced fit model is more acceptable than lock and key model. In 1958, an American biologist Deniel Koshland suggested a modification to the lock and key model and proposed the induced fit model. According to this model the active sites are not rigid structures rather it is molded into the required shape to perform its function.

Q:23. What is optimum temperature for human enzymes?

Ans. The optimum temperature for the maximum working speed of human enzymes is 37^{o}c.

Q:24. How enzymes lower the activation energy?

Ans. Enzymes lower the activation energy in several ways. They do so by;

(i) Altering the shape of the substrates and reducing the amount of energy required to complete the transition.

(ii) Disrupting the charge distribution on substrates.

(iii) Bringing substrates in the correct orientation to react.

Q:25. Define protease?

Ans. Protease is an enzyme which breaks peptide bonds in protein.

Q:26. What is the main use of enzymes in paper industry?

Ans. Enzymes break starch to lower its viscosity that aids in making paper.

Unit 07

BIOENERGETICS

Q.1. What do you know about energy of living organisms? Give its forms?

Ans. A living cell exhibits ceaseless chemical activities. Substances are broken down inside the cells and new substances are formed. Energy drives all these processes in a cell.

Energy exists in two forms in living organisms:-

(i) Kinetic Energy

It is actively involved in doing work.

(ii) Potential Energy

The potential energy is stored in chemical bonds. It is used for future use. It is released as kinetic energy when these bonds break.

Q.2. Describe bioenergetics and the role of ATP.

Ans. Definition

Bioenergetics is the study of energy relationships and energy transformations (conversions) in living organisms.

Explanation

Organisms obtain energy by metabolizing the food they eat or prepare. Food contains potential energy in its bonds. When these bonds are broken down, a large amount of kinetic energy is released. Some of this energy is stored in the form of potential energy in the bonds of ATP molecules while the rest escapes as heat. The potential energy stored in ATP is again transformed into kinetic energy to carry out the life activities.

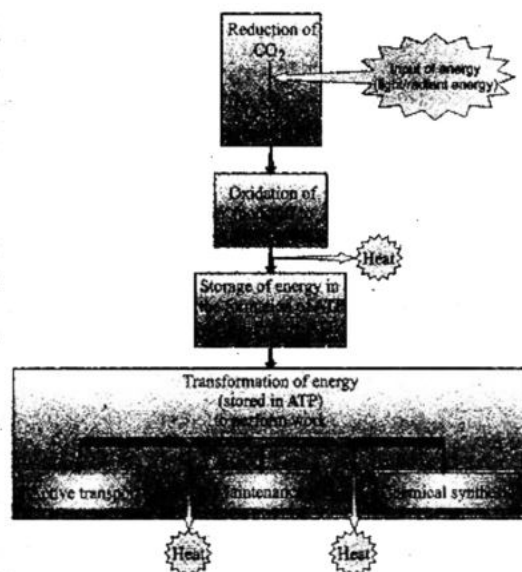



Figure 7.1: Some energy transformation pathways in living systems. Note that heat is lost in every transformation

Q.3. (a) How would you define bioenergetics while relating it to the oxidation-reduction reactions in living systems?

(b) How electrons act as an energy source?

Ans. (a) Bioenergetics:

Definition: Bioenergetics is the study of energy relationships and energy transformations in living organisms.

Oxidation Reduction Reactions in Living Organisms:

For all life processes, oxidation reduction reactions are the direct source of energy. Oxidation reduction reactions involve exchange of electrons between atoms.

Oxidation: In oxidation reaction, loss of electrons while in **Reduction** the gain of electrons takes place.

These reactions always run simultaneously and are also called **Redox reactions**.

Processes involved in Energy Flow:

The various life processes in organisms involve constant flow of energy. This energy flow comprises the acquisition, transformation and use of energy like

(i) Growth

(ii) movement

(iii) reproduction etc.

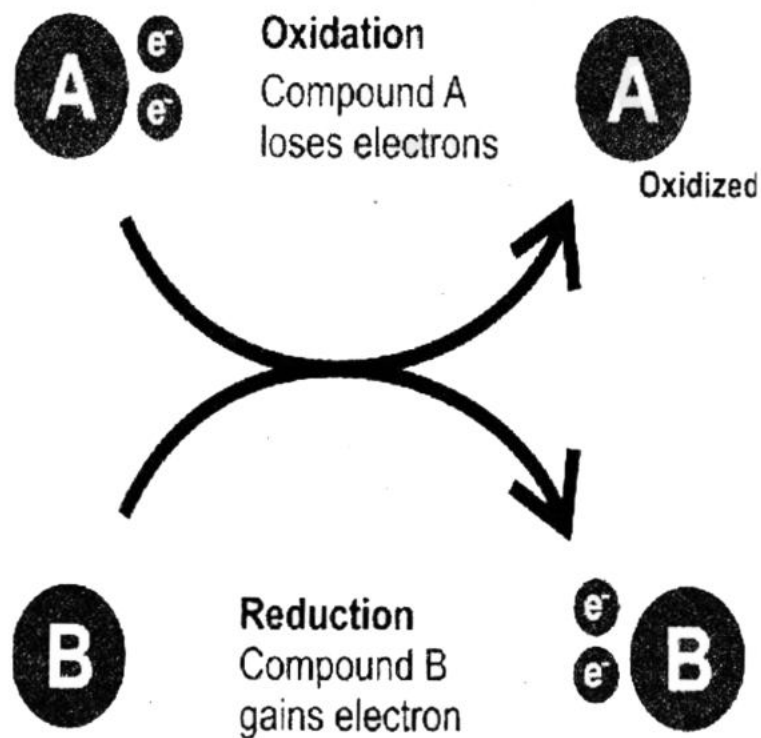



Figure 7.2: **Redox Reactions**

(b) Electrons as an Energy Source:

Electrons can be an energy source. It depends upon their:

(i) Location in atoms

(ii) Arrangement in atoms

Example: When electrons are present in oxygen, they make stable association with oxygen atom and are not good energy source.

But if electrons are dragged away from oxygen and attached to some other atom e.g. carbon or hydrogen, they make unstable association. They try to move back to oxygen and when this happens, energy is released. In this way, electrons act as an energy source.

Redox reactions in living organisms

In living organisms, redox reactions involve the loss and gain of hydrogen atoms. It means that when a molecule loses a hydrogen atom, it actually loses an electron and similarly when a molecule gains hydrogen atom, it actually gains an electron.

Q4.(a) Interpret that ATP is the chief energy currency of all cells.

(b) Describe the molecular structure of ATP.

Ans. (a) ATP: The Cell's Energy Currency:

The major energy currency of all cells is a nucleotide called ATP (Adenosine triphosphate).

Discovery: ATP was discovered by Karl Lohmann in 1929.

It was proposed to be the main energy transfer molecule in the cell by Nobel Prize winner, Fritz Lipmann in 1941.

ATP: The main energy source in cellular functions:-

ATP is the main energy source for majority of the cellular functions like the:

(i) Synthesis of macromolecules (DNA, RNA, proteins)

(ii) Movement

(iii) Transmission of nerve impulses

(iv) Active transport

(v) Exocytosis and Endocytosis

Value of energy:

The energy released when one phospohate bond is broken is 7.3 k cal/mol or 7300 calories per mole of ATP.

Phosphate groups
P~P~P
Ribose
1
2
3
4
Adenosine monophosphate (AMP)
Adenosine diphosphate (ADP)
Adenosine triphosphate (ATP)

(Figure 7.3) olecular structure of Adenosine Triphosphate (ATP)

Ans (b). Molecular Structure of ATP:

Subunits in ATP molecule:

Each ATP molecule has three subunits.

(i) Adenine: a double ringed nitrogenous base.

(ii) Ribose: a five-carbon sugar.

(iii)Three phosphate groups in a linear chain.

Covalent Bond in ATP:

The covalent bond connecting two phosphates is indicated by the "tilde" (~) and it is a high energy bond.

Energy value:

The energy in this bond is released as it breaks and inorganic phosphate (Pi) gets separated from ATP.

The breaking of one phosphate bond releases about 7.3 k cal (7300 calories) per mole of ATP.

$$ATP + H_2O \longrightarrow ADP + Pi + energy\ (7.3\ kcal/mol)$$

Q.5. (a) What do you know about energy values during the breaking of ATP?

Ans. Breakdown of ATP to AMP occurs in the following way:-

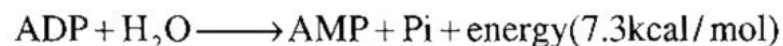
(i) Breakdown of ATP to ADP:

In common energy reactions, only the outermost of the two high energy bonds break. When this happens, ATP becomes ADP and one Pi is released.

$$ATP + H_2O \longrightarrow ADP + Pi + energy(7.3kcal/mol)$$

(ii) Breakdown of ADP to AMP:

In some cases, ADP is further broken down to AMP (Adenosine Monophosphate) and one Pi is released.

$$ADP + H_2O \longrightarrow AMP + Pi + energy(7.3kcal/mol)$$

(ii) ADP – ATP Cycle

Cells constantly recycle ADP by recombining it with Pi to form ATP. The synthesis of ATP from ADP and p_i requires the consumption of 7.3 k cal of energy per mole. So energy is used which is generated by energy releasing processes.

Q.6. (a) Define photosynthesis. Discuss it with its chemical equation.

(b) How the intake of water and CO_2 takes place for photosynthesis?

OR

Which phenomenon are involved in the intake of CO_2 and water by plants?

Ans. (a) Photosynthesis:

Definition:

The process by which plants and some other autotrophic organisms prepare their food (glucose) in the presence of sunlight and chlorophyll, with oxygen as a by-product is called photosynthesis.

Importance:

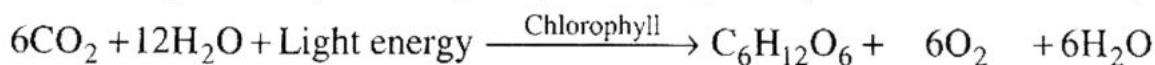
Photosynthesis is an anabolic process and is an important component of bioenergetics in living systems. It is the most important bio-chemical pathway and nearly all life depends on it.

Occurrence:

Photosynthesis occurs in plants, protists (algae) and some autotrophic bacteria.

Chemical Equation:

The chemical equation representing the process of photosynthesis is as follows;

$$6CO_2 + 12H_2O + \text{Light energy} \xrightarrow{\text{Chlorophyll}} C_6H_{12}O_6 + \quad 6O_2 \quad + 6H_2O$$

Ans. (b) Intake of water and CO_2 for Photosynthesis:

Water and CO_2 are the raw materials of photosynthesis. The plants have mechanisms for the intake and transport of these materials.

Intake of water

Water present in soil is absorbed by roots and root hairs through osmosis. This water is eventually transported to leaves through xylem vessels.

(After the entry of water in the inner cells of the root, it reaches xylem vessels).

(ii) Intake of CO_2:

The air that enters the leaf through tiny pores (stomata) reaches into the air spaces present around mesophyll cells.

This air carries CO_2 which gets absorbed in the thin layer of water surrounding the mesophyll cells. From here, the CO_2 diffuses into the mesophyll cells.

Q.7. Describe the mechanism of photosynthesis in detail.

Ans. Phases in Photosynthesis:

Photosynthesis occurs in two phases;

(i) Light Reactions

In this phase, light energy is captured and is used to make high energy molecules ATP and NADPH. These reactions are known as light reactions. These take place on thylakoid membranes of chloroplast.

(ii) Dark Reactions

It is second phase of photosynthesis in which carbon dioxide is reduced to make glucose. In this phase energy from high energy molecules (ATP and NADPH) is utilized. It takes place in the stroma of chloroplasts. Since these reactions do not use light directly, they are known as dark reactions.

Figure 7.4: Summary of photosynthesis

(i) Light Reactions:

The reactions taking place during first phase of photosynthesis are called light reactions or light dependent reactions as they occur in the presence of light to make high energy molecules, ATP and NADPH.

Summary of Light Reactions:

The events that take place during the light reactions are as follows;

Figure 7.5: Light reactions of photosynthesis

(i) Emission of electrons

When chlorophyll molecules absorb light, their energy level increases and their electrons are emitted.

(ii) Production of ATP:

Electrons are passed to Electron Transport Chains to produce ATP.

(iii) Photolysis: (photo: light, lysis: break down)

Light breaks water molecule (photolysis) and oxygen is released. The hydrogen atoms of water give electrons to chlorophyll and become ions.

(iv) Reduction of $NADP^+$ to NADPH:

After the production of ATP, the electron of chlorophyll and the hydrogen ions of water are used for the reduction of $NADP^+$ into NADPH

Z - Scheme.

The whole series of light reactions is called Z-scheme due to its Z-shaped flow chart.

Dark Reaction:

Introduction

It is a light independent reaction which occurs at night.

Discovery: The details of dark reactions were discovered by Melvin Calvin and his Collegues at the University of California.

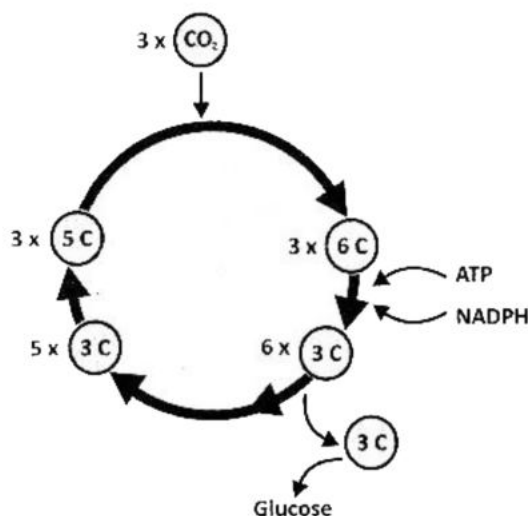
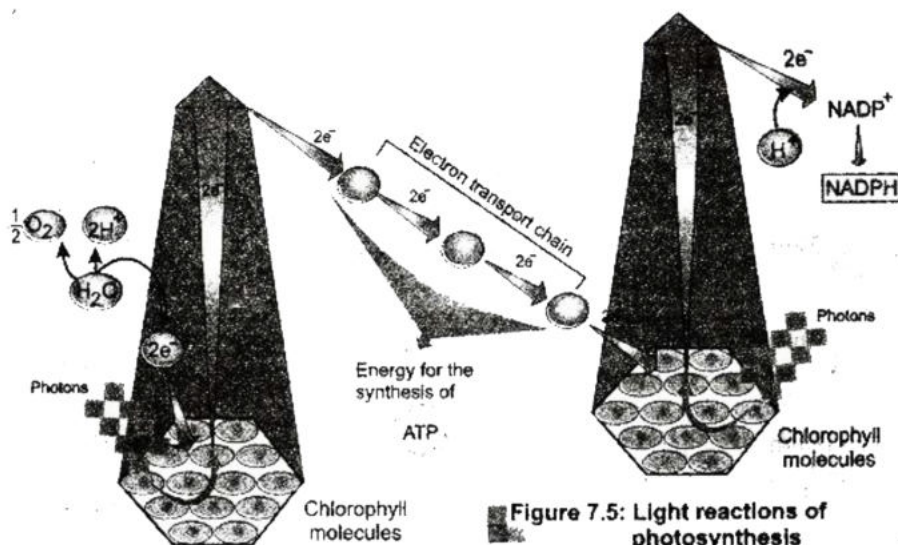
Due to this, summary of the events of dark reactions are also called Calvin Cycle.

(i) (a) Formation of 6-carbon compounds:

CO_2 molecules are combined with 5-carbon compounds to form temporary 6-carbon compounds.

(b) Splitting of 6-carbon compounds:

Each of 6-carbon compound splits into two 3-carbon compounds.

Figure 7.6: Dark reaction of photosynthesis (The Calvin cycle)

(ii) Reduction of 3-carbon compounds:

The 3-carbon compounds are reduced to 3-carbon carbohydrates by using ATP and hydrogen from NADPH.

The 3-carbon carbohydrates are used to manufacture glucose.

(iii) Regeneration of original 5-carbon compound:

The 3-carbon carbohydrates are also used to regenerate the original 5-carbon compound. This step utilizes ATP.

Q.8. Explain the role of chlorophyll and light in photosynthesis.

Ans. Role of Chlorophyll and light in Photosynthesis:

(i) Chlorophyll: sunlight is absorbed by chlorophyll. It is then converted into chemical energy which drives the photosynthetic process.

(ii) Only about one percent of the light falling on the leaf surface is absorbed, the rest is reflected or transmitted.

Photosynthetic Pigments:

(i) The light rays of different wavelengths are not only differently absorbed by photosynthetic pigments but are also differently effective in photosynthesis.

(ii) The blue and red lights carry out more photosynthesis which are absorbed by pigments.

Photosystems:

The photosynthetic pigments are organized in the form of clusters, called photosystems, in thylakoid membranes of chloroplasts.

Main Photosynthetic pigment:

Chlorophyll a is the main photosynthetic pigment.

Accessory Pigments:

Additional pigments like chlorophyll b and carotenoids are called accessory pigments. Some wavelengths not absorbed by chlorophyll 'a' are very effectively absorbed by accessory pigments and vice versa.

Q.9. Explain the limiting factors in photosynthesis. **(Lahore board 2011 G II)**

Ans. Limiting factors in photosynthesis:

Definition (Limiting Factors):

"Any environmental factor the absence or deficiency of which can decrease the rate of a metabolic reaction is called limiting factor"

Limiting Factors

(i) Light intensity
(ii) Temperature
(iii) Concentration of CO_2
(iv) Availability of water.

1) **Effect of light Intensity:**

The rate of photosynthesis varies with light intensity.

(i) It decreases as the light intensity decreases and increases as the intensity increases.

(ii) However at much higher light intensity, the rate of photosynthesis becomes constant.

2) **Effect of Temperature:** **(Lahore board 2012 G I)**

(i) The rate of photosynthesis decreases with decreases in temperature.

(ii) It increases as the temperature is increased over a limited range.

(iii)But if light intensity is low, increasing the temperature has little influence on the rate of photosynthesis.

3) **Effect of Carbon dioxide Concentration:**

(i) Carbon dioxide concentration raises the rate of photosynthesis, it goes on increasing until limited by other factors.

(ii) Increase in CO_2 concentration beyond a certain level causes the closure of stomata and it decreases the rate of photosynthesis.

Q.10. Define respiration. Describe its types and importance.

Ans. Respiration

Definition

In cellular respiration, food is oxidized to CO_2, H_2O and energy is released.

Explanation

Organisms utilize oxygen for the break down of C-H bonds present in the food in their cells. This yields energy. During this process, oxidation-reduction reaction breaks C-H bonds and so carbon dioxide and water are also produced. This cellular energy yielding process is called cellular repiration.

Types of respiration.

There are two methods of respiration.

(i) Aerobic respiration

(ii) Anaerobic respiration

(i) **Aerobic respiration:**

Definition:

It is that type of respiration in which complete oxidation of glucose occurs with maximum release of energy in the presence of oxygen.

First phase:

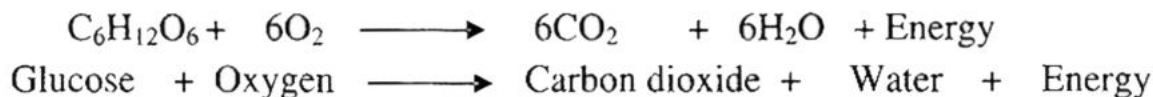
A molecule of glucose (6-C) is broken down into two molecules of pyruvic acid. (3-C)

Second phase:

Pyruvic acid is completely oxidized. All (C-H) bonds are broken and CO_2 and water is formed.

Equation

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + \text{Energy}$$

Glucose + Oxygen ⟶ Carbon dioxide + Water + Energy

(ii) Anaerobic respiration (Fermentation)

Definition

Some organisms oxidize their food incompletely without using any molecular oxygen called anaerobic respiration. Glucose is incompletely oxidized with less amount of energy released.

By this process less amount of energy is produced by one molecule of glucose.

Explanation

First Phase:

In anerobic respiration, the first phase is exactly similar to that of aerobic respiration. A molecule of glucose is broken down into two molecules of Pyruvic acid.

Second Phase:

In the second phase, Pyruvic acid is not completely oxidized. It is transformed into ethyl alcohol or lactic acid. In this way many of the C – H bonds are left unbroken in the products.

Types of anaerobic respiration:

Anaerobic respiration is further classified as:-

(i) Alcoholic fermentation. **(ii)** Lactic acid fermentation

(i) Alcoholic fermentation

It occurs in bacteria and yeast. In this type of anaerobic respiration, pyruvic acid is further broken down into alcohol (C_2H_5OH) and CO_2.

Pyruvic acid → Ethyl alcohol + carbon dioxide

(ii) Lactic acid fermentation

It occurs in skeletal muscles of humans and other animals during extreme physical activities. This also happens in the bacteria present in milk.

In this type each pyruvic acid molecule is converted into lactic acid ($C_3H_6O_3$)

Pyruvic acid → Lactic acid

Importance of anaerobic respiration

Importance of anaerobic respiration are as follows:-

(i) Early life

The earth in early time had environment which was totally devoid of oxygen.

The organisms respire anaerobically to drive their energy. So life started on earth anaerobically.

(ii) Anaerobes

Some existing bacteria and Fungi live ,in oxygen free environment respire anareobically and called anaerobes.

(iii)Anaerobic respiration in active tissues

In some active tissues like skeletal muscles during exercise when oxygen supply can not keep pace with energy demand so anaerobic respiration provides energy by break down of glucose into lactic acid.

(iv)Uses of Fermentation

Scientists have used fermenting abilities of bacteria and fungi for benefit of mankind.

(i) Fermenting power of bacteria are used for making cheese and yogurt.

(ii) Fermentation in yeast is used in brewing and baking industries.

(iii) A fungus, Aspergillus is used to make soya sauce.

Q.11. Describe mechanism of respiration.

Ans. Mechanism of respiration

The process of respiration involves complex series of reactions. For the study of all the reactions of glucose oxidation, we will study the mechanism of aerobic respiration. Aerobic respiration is a continuous process but we can divide into three main stages.

(i) Glycolysis

(ii) Krebs cycle

(iii) Electron Transport chain

(i) Glycolysis

Location:

Glycolysis occurs in cytoplasm and oxygen is not involved at this stage so it occurs both in aerobic and anaerobic respiration.

Definition:

The process in which glucose molecule is broken into two molecules of pyruvic acids (3c).

(ii) Kreb's cycle

Discovery A British biochemist, Sir Hans Krebs discovered this series of reactions that is why it is called the krebs cycle

Definition: In Krebs cycle, pyruvic acid molecules are completely oxidized along with the formation of ATP, NADH and $FADH_2$.

Before entering in Krebs cycle, pyruvic acid is changed into a 2- carbon compound called acetyl COA.

(iii)Electron Transport chain

It is the final step of cellular respiration. It is the transfer of electron in an electron transport chain. In this step,

i. NADH and $FADH_2$ release electrons and hydrogen ions
ii. These electrons are taken up by a series of electron carriers.
iii. When electrons move, through the series of electron carriers they lose energy, which is used to synthesize ATP.
iv. At the end of chain, electrons and hydrogen ions combine with molecular oxygen and form water.

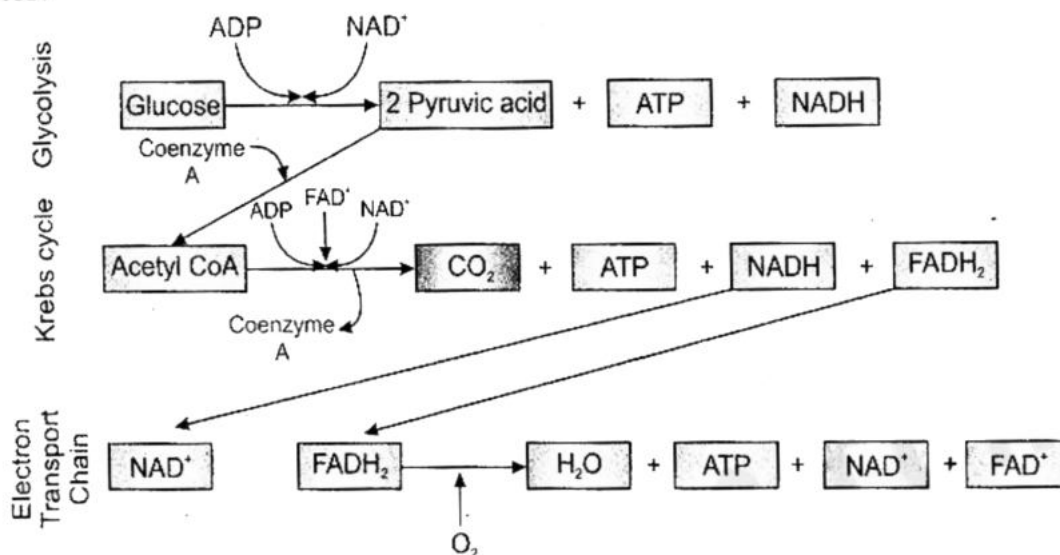



Figure 7.7: **Mechanism of respiration**

Q.12. Describe energy budget of respiration?

Ans. Energy budget of Respiration

Energy is produced in following steps.

(i) Each NADH molecule generated in glycolysis gives 2 ATP because 1 ATP is consumed to transport it across the mitochondrial membrane, and in krebs cycle and Electron Transport Chain produces 3ATP.

(ii) Each $FADH_2$ produces 2ATP

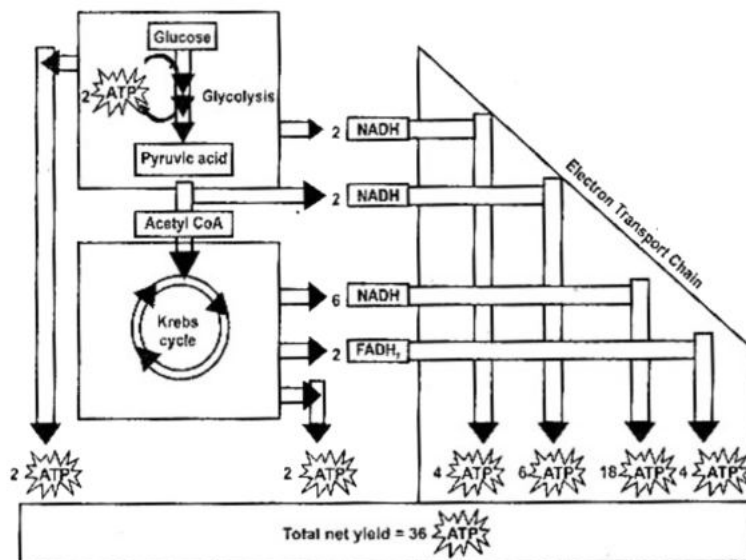



Figure 7.8: Energy chart of respiration

Total calculation from chart.
Total ATP molecules = 4 ATP
ATP from 10 NADH = 28 ATP
ATP from 2 FADH2 = 4 ATP

Total ATP = 36 ATP

Result: During anaerobic respiration oxidation of a glucose molecule produces 2 ATP as there is no krebs cycle and electron transport chain in anaerobic respiration. (Lahore board 2012 G II)

Table 7.1 Differences between aerobic and anaerobic respiration

Properties	Aerobic respiration	Anaerobic respiration
Presence of Oxygen	Yes	No
Number of ATP as net profit	36	2ATP
Final products	CO_2 , H_2O	Lactic acid or Ethanol + CO_2
Site of occurrence	Gycolysis in cytoplasm and Krebs cycle and electron transport chain in mitochondria	In cytoplasm
Importance	Major source of energy for most organisms	Source of energy for anaerobic organism Source of energy for aerobic organisms in short supply of O_2. Source of many products (ethanol, cheese etc)

Table 7.2 Differences between Photosynthesis and Respiration

Characteristics	Photosynthesis	Respiration
Metabolism	Anabolism	Catabolism
Energy investment / production	Investment of light energy to store it in the form of bond energy.	Bond energy transformed into chemical energy of ATP
Organisms capable of;	Some bacteria, all algae all chlorophyllous plants	All organisms
Site of occurrence	Chloroplasts	In cytoplasm and mitochondria
Time of occurrence	In daytime only, in the presence of light	All the time

Multiple Choice Questions

1. In which of the following steps of respiration, CO_2 is produced?
(a) Glycolysis (b) Krebs cycle
(c) electron transport
(d) All of these

2. Oxygen takes part in aerobic respiration in
(a) Glycolysis
(b) link step between Glycolysis and krebs cycle
(c) Krebs cycle
(d) electron transport chain

3. When a plant was kept in darkness for many days, its leaves turned yellow. Why?
(a) Leaves could not get oxygen and so there was no photosynthesis
(b) Leaves could not get light and so there was no respiration
(c) Leaves could not get oxygen and so there was no respiration
(d) Leaves could not get light and so there was no photosynthesis.

4. From which bonds of ATP molecule, energy is taken?
(a) P-P bonds (b) C-H bonds
(c) C-N bonds (d) C-O bonds

5. In which component of the leaf cells, chlorophyll is present?
(a) stroma (b) Thylakoids
(c) Plasma membrane (d) Cytoplasm

6. Which of these can enter into krebs cycle?
(a) Glucose (b) Pyruvic acid
(c) citric acid (d) Acetyl Co – A

7. When we work hard we suffer from muscle fatigue because muscle cells
(a) Carry out aerobic respiration at faster rate and so are tired
(b) Carry out anaerobic respiration and so accumulate more CO_2
(c) Carry out anaerobic respiration and so accumulate lactic acid
(d) Carry out aerobic respiration at faster rate and so accumulate lactic acid

8. How many molecules of CO_2 are produced when krebs cycle operates once?
(a) 01 (b) 02
(c) 03 (d) 06

9. The potential energy is stored in chemical bonds and is released as__________energy when these bonds break.
(a) Heat (b) Light
(c) Kinetic (d) Solar

10. Fungi and __________ bacteria get the prepared food.
(a) Motile (b) Non-motile
(c) Photosynthetic
(d) Non-photosynthetic

11. __________ reactions are the direct source of energy.
(a) Oxidation (b) Redox
(c) Reduction (d) None

12. Redox reactions involve exchange of __________.
(a) Electrons (b) Protons
(c) Neutrons (d) Atoms

13. In living organisms, redox reactions involve the loss and gain of __________ atom.

(a) Oxygen (b) Carbon
(c) Nitrogen (d) Hydrogen

14. The major energy currency of all cells is:

(a) ADP (b) ATP
(c) AMP (d) P-bonds

15. Ribose is a __________ carbon sugar.

(a) Two (b) Three
(c) Five (d) Ten

(Lahore board 2011 G I)

16. There are __________ P-bonds in an ATP molecule.

(a) Two (b) Nine
(c) Six (d) Four

17. The breaking of one phosphate bond releases ___ kcal/mole of ATP.

(a) 7.9 (b) 7.5
(c) 7.1 (d) 7.3

18. Photosynthesis is a /an_____ process.

(a) Metabolic (b) Catabolic
(c) Anabolic (d) Chemical

19. __________ is an inorganic compound of carbon which have poor energy value.

(a) Glucose (b) CO_2
(c) ATP (d) NADPH

20. __________ is a co-enzyme.

(a) NAD^+ (b) NADH
(c) AMP (d) None

21. The raw materials in photosynthesis are

(a) Water, Oxygen (b) CO_2, O_2
(c) Water, CO_2 (d) Glucose,Water

22. The water from the soil enters into the root hairs by the process of

(a) Photosynthesis (b) Osmosis
(c) Diffusion (d) Respiration

23. The air enters the leaf through _____.

(a) Pits (b) Stomata
(c) Mesophyll (d) Xylem vessels

24. The light reactions of photosynthesis take place on the __________ of chloroplasts.

(a) Stroma
(b) Thylakoid membrane
(c) Lumen (d) Sacs

25. The reactions which do not require light during photosynthesis are called _______reactions.

(a) Chemical (b) Redox
(c) Dark (d) Light

26. Electrons are passed to ETC to produce:

(a) AMP (b) ATP
(c) ADP (d) NAD^+

27. The 6-carbon compounds during the dark reactions of photosynthesis split into ______ carbon compound.

(a) 5 (b) 3
(c) 7 (d) 4

28. How many percent of the light falling on the leaf surface is absorbed;

(a) 5% (b) 6%
(c) 7% (d) 1%

29. Exchange of water vapours and gases occurs in leaf through;

(a) Stomata (b) Epidermis
(c) Xylem (d) Phloem

30. Any environmental factor, the absence or deficiency of which can decrease the rate of a metabolic relations known as;

(a) Unlimited factor
(b) Limiting factor
(c) Both (d) None

31. Vessels, which transport water and salts to the plant are the components of:-
(a) Xylem (b) Phloem
(c) Vascular tissues (d) All

32. Photosynthesis takes place in:
(a) Chloroplasts (b) Cytoplasm
(c) mitochondria (d) All

33. Final products of anaerobic respiration is:
(a) Lactic acid (b) Ethanol
(c) CO_2 (d) All

34. Glycolysis occurs in:
(a) Cytoplasm (b) Stroma
(c) Nucleus (d) All

35. Fungi Aspergillus is used for making:
(a) Yogurt (b) Cheese
(c) Soy Sauce (d) Baking

36. Pyruvic acid is a________Carbon compound.
(a) 5 (b) 4
(c) 3 (d) 2

37. In which of the following metabolic process, oxidation as well as reduction of molecules occur?
(a) Photosynthesis (b) Respiration
(c) Both (d) None of these

38. Chlorophyllous pigment absorbs maximum light in wavelengths of:
(a) Green and blue
(b) Green and red
(b) Green only
(d) Red and blue **(Lahore board 2011 G I)**

39. ATP was discovered by:
(a) Schwann (b) J.Purkinji
(c) Darwin (d) Karl Lohmann
(Lahore board 2011 G II)

Answers

1.	**b**	6.	**d**	11.	**a**	16.	**a**	21.	**c**	26.	**b**	31.	**a**	36.	**C**
2.	**c**	7.	**c**	12.	**a**	17.	**d**	22.	**b**	27.	**b**	32.	**a**	37.	**c**
3.	**d**	8.	**b**	13.	**d**	18.	**c**	23.	**b**	28.	**d**	33.	**d**	38.	**d**
4.	**a**	9.	**c**	14.	**b**	19.	**b**	24.	**b**	29.	**a**	34.	**a**	39	**d**
5.	**b**	10	**d**	15.	**c**	20.	**a**	25.	**c**	30.	**b**	35.	**c**		

Short Questions

Q.1. What is acetyl CO A?

Ans. Before entering in krebs cycle, pyruvic acid combines with coenzyme A and changed into a 2- Carbon Compound called acetyl Co-A.

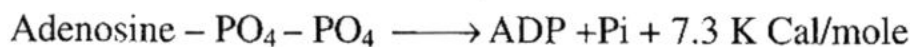
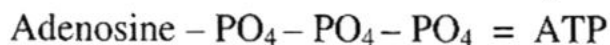
Q.2. What is Adenine?

Ans. It is a double-ringed nitrogenous base used in the molecular structure of ATP.

Q.3. What is ADP?

Ans. ADP stands for Adenosine Diphosphate. When terminal bond of ATP is broken, a large amount of energy is released and ATP is converted into ADP. The breaking of one phosphate bond releases about 7300 calories per mole of energy.

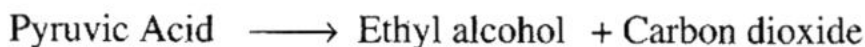
Adenosine – PO_4 – PO_4 – PO_4 = ATP

Adenosine – PO_4 – PO_4 $\longrightarrow$ ADP +Pi + 7.3 K Cal/mole

Q.4. Define Aerobic respiration. **(Lahore board 2011 G II)**

Ans. A type of respiration in which glucose is completely oxidized by free form of oxygen and as a result, 686000 calories per mole energy is released.

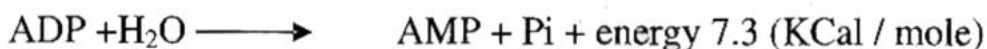
Q.5. What is Alcoholic fermentation? **(Lahore board 2011 G I)**

Ans. In this type of anaerobic respiration, Pyruvic acid is further broken down into alcohol (C_2H_5OH) and CO_2.

Pyruvic Acid $\longrightarrow$ Ethyl alcohol + Carbon dioxide

2ATP molecules of energy are produced. It occurs in bacteria and yeast.

Q.6. What is AMP?

Ans. AMP stands for adenosine monophosphate. ADP is broken down to AMP and Pi is released.

ADP +H_2O $\longrightarrow$ AMP + Pi + energy 7.3 (KCal / mole)

Q.7. Define Anabolism.

Ans. There are certain constructive chemical reactions in which smaller molecules combine together to form complex structures which occur in our bodies. These are called anabolic reactions and the process is called anabolism e.g. photosynthesis and assimilation of food.

Q.8. Define Anaerobic respiration (Fermentation).

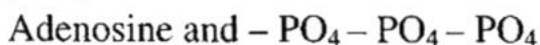
Ans. Some organisms oxidize their food incompletely without using any molecular oxygen called anaerobic respiration. It is of two types:

(ii) Lactic acid fermentation.

(iii) Alcoholic fermentation.

Q.9.What is ATP? **(Lahore board 2011 G I)**

Ans. ATP is abbreviation of adenosine tri-phosphate. It contains adenosine and three phosphates.

Adenosine and – PO_4 – PO_4 – PO_4

ATP is energy currency. It is a packet of energy produced in mitochondria by oxidation of glucose.

Q.10. What do you mean by the term Autotrophic?

Ans. The term autotrophic is applied to those organisms which can prepare their own food with the help of chlorophyll (photosynthesis) are called autotrophic.

Examples:

Green Plants, algae, some bacteria.

Q.11. Define bioenergetics.

Ans. Bioenergetics is the study of energy relationships and energy transformations (conversions) in living organisms.

Q.12. What is Calvin cycle?

Ans. Calvin cycle is also called dark reaction. Dark reaction is second phase of photosynthesis. It does not require light energy. In this reaction, glucose is synthesized in the absence of sunlight but energy required is obtained by NADPH and ATP formed during light reaction.

Q.13. What is Chlorophyll?

Ans. Chlorophyll is a green pigment inside the chloroplasts of plant cells. It enables plants to capture solar radiations to convert them into chemical energy of glucose.

Q.14. Define Coenzyme –A.

Ans. The enzyme which combines with pyruvic acid to form acetyl COA before entering krebs cycle is called coenzyme A.

Q.15. Define Electron Transport Chain (ETC). **(Lahore board 2012 G II)**

Ans. The final phase of cellular respiration in which the compounds NADH and $FADH_2$ are oxidized and their electrons pass along a chain of oxidation reduction steps to produce ATP. This chain is called Electron Transport Chain.

Q.16. What is FAD?

Ans. Flavin adenine dinucleotide (FAD) is also a coenzyme like NAD^+. It gets 2 hydrogen and reduces to $FADH_2$

Q.17. What is Glycolysis?

Ans. It is the first stage of aerobic respiration. In glycolysis, glucose is converted into Pyruvic acid. It occurs in cytoplasm and Oxygen is not involved in this stage.

Q.18. What is Krebs cycle?

Ans. It is the second stage of aerobic respiration. In krebs cycle, the Pyruvic acid molecules are completely oxidized into CO_2 and H_2O.

Q.19. What is Lactic acid Fermentation?

Ans. Introduction

It is a type of anaerobic respiration. Each Pyruvic acid molecule is converted into lactic acid ($C_3H_6O_3$).

Pyruvic acid $\longrightarrow$ Lactic acid

Occurrence

It occurs in skeletal muscles of humans and other animals during extreme physical activities when Oxygen cannot be transported to the cells as rapidly as it is needed. This also happens in the bacteria present in milk.

Q.20. Define light-dependent reactions. **(Lahore board 2012 G I)**

Ans. Light dependent reaction (light reaction): During the first phase of Photosynthesis, light energy is captured and is used to make high energy molecules i.e. ATP and NADP. It takes place in thylakoid membranes of chloroplast.

These reactions take place in the stroma of the chloroplast.

Q.21. What are limiting factors?

Ans. Any environmental factor, the absence or deficiency of which can decrease the rate of a metabolic reaction is called limiting factor.

Q.22. What is Mesophyll?

Ans. The inner tissues of a leaf whose cells are green because they contain chloroplast (chlorophyll) is called mesophyll. The process of photosynthesis occurs here.

Q.23. Define Metabolism. **(Lahore board 2012 G II)**

Ans. The sum of all chemical processes (reaction) (Anabolism + Catabolism) taking place in living organisms is called metabolism.

Q.24. NADPH stands for what?

Ans. NAD (Nicotinamide adenine dinucleotide) is a co-enzyme that takes phosphate and hydrogen ions and is thus reduced to NADPH.

Q.25. Define Oxidation and Reduction reactions.

Ans. Oxidation: Addition of oxygen, removal of hydrogen or the loss of electrons is called oxidation. Oxidation is energy yielding process.

Reduction: Addition of hydrogen, removal of oxygen or the gain of electrons is called reduction. Reduction is energy consuming process

Q.26. Define photolysis.

Ans. (Photo: Light, lysis: breakdown) the breakdown of water molecules in the presence of light to release oxygen is called photolysis. Photolysis occurs in the light reaction (1^{st} phase) of photosynthesis.

Q.27. Define photosynthesis. **(Lahore board 2011 G II)**

Ans. Definition: The process by which plants and some other autotrophic organisms prepare their food (in the form of glucose) in the presence of sunlight and chlorophyll is called photosynthesis.

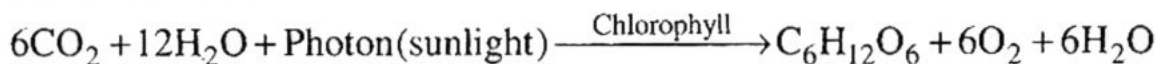
OR

"Photosynthesis is the synthesis of glucose from CO_2 and water in the presence of sun light and chlorophyll with O_2 as a by-product."

OR

"In this process, the energy-poor inorganic oxidized compounds of carbon (i.e. CO_2) are reduced to energy rich carbohydrates (i.e. "glucose")

Chemical Equation:

$$6CO_2 + 12H_2O + \text{Photon(sunlight)} \xrightarrow{\text{Chlorophyll}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

It is an anabolic process and nearly all life depends on it.

Q.28. What are photosystems?

Ans. Photosynthetic pigments are organized into clusters for efficient absorption and utilization of solar/light energy in thylakoid membranes. These clusters are called photosystems.

Q.29. What are Pigments?

Ans. Pigments are the coloured substances that absorb visible light. Different pigments absorb light of different wavelengths. Chlorophyll a, chlorophyll b and carotenes are pigments effective for photosynthesis.

Q.30. What is pyruvic acid?

Ans. In the first step of respiration, a molecule of glucose (6-C) is broken down into two molecules of pyruvic acid. It is a 3-C Compound.

Q.31. What is respiration?

Ans. The oxidation of food in order to obtain energy is called respiration. The respiration takes place in a cell called cellular respiration.

Q.32. What is stroma?

Ans. Stroma: Chloroplast has a double membrane envelope that encloses dense fluid-filled region called stroma which contains most of the enzymes required to produce carbohydrate molecules.

Q.33. What is Thylakoid?

Ans. Another system of membranes is embedded in the stroma of chloroplast. These membranes form an interconnected set of flat, disc like sacs called thylakoids.

Chlorophyll (and other photosynthetic pigments) are found embedded in the thylakoid membranes and give green colour to the plant.

Q.34. What do you mean by Z-scheme?

Ans. The path of electrons through the two photosystems during light reaction of photosynthesis is called Z-scheme due to its Z-shaped form. **OR**

The whole series of light reactions is called Z-scheme due to its Z-shaped form.

Q.35. What is Light Independent Reaction (Dark Reaction)? **(Lahore board 2012 G I)**

Ans. Light Independent Reaction: During the second phase of photosynthesis, CO_2 is reduced to make glucose. The energy in the light form of ATP is utilized and stored in the

bonds of glucose. Since these reactions do not use light directly, they are known as light independent reactions.

Q.36. What are redox reactions?

Ans. Oxidation reduction reactions (involve exchange of electrons occur simultaneousley) are also called redox reactions.

Q.37. Who discovered ATP and who proposed it as energy-transfer molecule in the living cell?

Ans. Karl Lohmann discovered ATP in 1929 and Fritz Lipmann in 1941 proposed it as energy transfer molecule in living cell.

Q.38. Enlist the functions which are performed / carried out due to ATP?

Ans. Majority of the cellular functions are carried out due to ATP like the synthesis of macromolecules (DNA, RNA, Proteins), movement, transmission of nerve impulses, active transport, exocytosis and endocytosis etc.

Q.39. How much energy is released when one phosphate bond breaks in an ATP molecule?

Ans. 7.3 kilo calories / mole or 7300 calories / mole of ATP is released when one phosphate bond breaks.

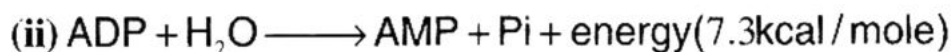
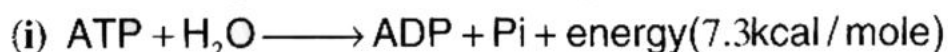
Q.40. What is the major energy currency in all living cells?

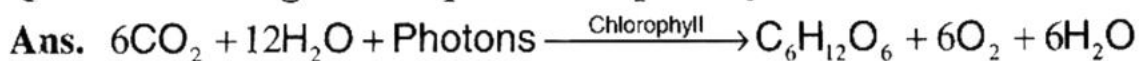
Ans. ATP i.e Adenosine Triphosphate is the major energy currency in all living cells.

Q.41. What are the conversion equations for ATP to AMP?

Ans. Following are the conversion equations for ATP to AMP:

(i) $ATP + H_2O \longrightarrow ADP + Pi + energy(7.3kcal/mole)$

(ii) $ADP + H_2O \longrightarrow AMP + Pi + energy(7.3kcal/mole)$

Q.42. Write the general equation for photosynthesis.

Ans. $6CO_2 + 12H_2O + Photons \xrightarrow{Chlorophyll} C_6H_{12}O_6 + 6O_2 + 6H_2O$

Q.43. What are the raw materials for photosynthesis?

Ans. CO_2 and water are the raw materials for photosynthesis.

Q.44. Define Osmosis.

Ans. Osmosis is the movement of water molecules from a region of dilute solution to the region of concentrated solution through a selectively permeable membrane.

Example:

The movement of water molecules along with salts from the soil into the roots and root hairs takes place through osmosis.

Q.45. How much the leaf surface is covered by stomata?

Ans. Stomata covers only 1-2% of the leaf surface.

Q.46. What are the locations for the occurrence of light and dark reactions?

Ans. Light reactions takes place on the thylakoid membranes of the chloroplast.

Dark reaction takes place in the stroma of the chloroplast.

Q.47. ATP, ADP and AMP stands for what?

Ans. ATP: Adenosine Triphosphate ADP: Adenosine Diphosphate

AMP: Adenosine Monophosphate

Q.48. What are Vascular tissues?

Ans. Conducting tissues in plants are called vascular tissues.

i. Xylem

Xylem transport salts and water from roots to different parts of the plants.

ii. Phloem

Phloem used for the conduction of food from leaves to the different parts of the plants.

Unit 08

NUTRITION

Q.1. Define Nutrition and Nutrients?

Ans. Nutrition

The process in which food is obtained or prepared, absorbed and converted into body substances for growth and energy is called nutrition.

Nutrients

These are the elements and compounds that an organism obtains and uses for energy source or for the synthesis of new materials. e.g., carbohydrates, proteins, lipids or fats etc.

Q.2. Describe types of organisms on the basis of nutrition?

Ans. Types of organisms

There are two types of organisms on the basis of nutrition.

i) **Autotrophic organisms**

The organisms which prepare their own food from inorganic elements are called autotrophic organisms. e.g. some bacteria, all algae and all plants.

They obtain water, carbon dioxide and minerals from their environment and prepare their food. This food is then used for growth and energy as well.

ii) **Heterotrophic organisms**

The organisms which obtain their food from other organisms are called heteretrophic organisms e.g., Most bacteria and all protozoans fungi and animals. They use food for growth and energy.

Q.3. How plants get their food? Explain briefly?

Ans. Plants are autotrophic and prepare their food through photosynthesis. Plants get carbon, hydrogen and oxygen from carbon dioxide and water. Plants also require mineral elements for various activities and structures.

Q.4. Define macronutrients and micronutrients. Explain mineral requirements of plants in detail? **(Lahore board 2011 G I & 2012 G II)**

Ans. Macronutrients

"The nutrients which are required by plant in larger quantities are called macronutrients." e.g., carbon, hydrogen, oxygen etc. These are nine in number.

Micronutrients

"The nutrients which are required by plant in small quantities are called micronutrients." e.g iron, boron etc. These are eight in number.

Table 8.1: Role of Mineral Elements in Plant Life

	Mineral elements	Role of Macronutrients in plant life
Macronutrients	Phosphorus (Lahore board 2011 G II)	Component of ATP, nucleic acids, and coenzymes, necessary for seed germination, photosynthesis, protein formation etc.
	Potassium	Regulates the opening and closing of the stoma, reduces water loss from the leaves
	Sulphur	Component of proteins, vitamins and enzymes
	Calcium	Activates enzymes, is a structural component of cell wall, influences water movement in cells
Micronutrients	Iron	Necessary for photosynthesis, activates many enzymes
	Molybdenum	Component of the enzyme that reduces nitrates to ammonia, important in building amino acids
	Boron	Important in sugar transport, cell division, and synthesizing certain enzymes
	Copper	Component of several enzymes
	Manganese	Involved in enzyme activity for photosynthesis, respiration, and nitrogen metabolism
	Zinc	Required in a large number of enzymes
	Chlorine	Involved in osmosis of water
	Nickel	Required in a nitrogen metabolism

- Carbon and oxygen are absorbed from air, while other elements are absorbed from the soil.

Q.5. What is the role of nitrogen and magnesium on plant growth?

(Lahore board 2011 G I) (short question)

Ans. Role of Nitrogen

- Plants get nitrogen in the form of nitrates.
- Nitrogen is a major component of proteins, hormones, chlorophyll, vitamins and enzymes essential for plant life.
- Nitrogen metabolism is major factor in stem and leaf growth.

Effects of deficiency of Nitrogen

- Deficiency of nitrogen can reduce yields.
- It also causes yellowing of leaves.
- Deficiency of nitrogen causes stunt growth.

Effects of excess of Nitrogen:

Too much nitrogen can delay flowering and fruiting.

Role of Magnesium

- Magnesium is a structural component of chlorophyll.
- It is necessary for functioning of plant enzyme to produce carbohydrates, sugars and fats.
- It is used for fruit and nut formation.
- It is essential for germination of seeds.

Effects of deficiency of Magnesium

- Deficiency of magnesium causes yellowing and wilting of leaves.

Q.6. How are Inorganic and Organic fertilizers important in agriculture?

Ans. Fertilizers

"The addition of certain materials to soil sometimes results in plant growth with desirable characteristics (e.g. more fruit, faster growth, more attractive flowers). Such materials are named as fertilizers."

Classification of fertilizers

Fertilizers are broadly classified as;

(i) Inorganic fertilizers

(ii) Organic fertilizers

Inorganic Fertilizers

"Naturally occurring materials which are not chemically modified are called inorganic fertilizers."

Example

Naturally occurring inorganic fertilizers include;

(i) Rock phosphate

(ii) Elemental sulphur

(iii)Gypsum

Nitrogen Fertilizers:

If nitrogen is the main element of fertilizers, they are called nitrogen fertilizers.

Importance of Inorganic Fertilizers

- Mostly inorganic fertilizers dissolve readily in water and are immediately available to plant for uptake.
- These fertilizers efficiently supply the required nutrients for plant growth.

Organic Fertilizers

"Materials which are more complex chemical substances that take time to be broken down into forms usable by plants are called organic fertilizers."

Example: Manure and compost

Origin

Organic fertilizers are derived from either plant or animal materials containing one or more essential elements.

Importance of Organic Fertilizers (Lahore board 2012 G I)

- Organic fertilizers have less salts so their larger amount can be applied without injury to plant roots.
- They can also increase soil drainage, aeration, water holding capacity.
- They can increase ability of soil to hold nutrients.

Q.7. Discuss the hazards of environment related to fertilizers' use?

Ans. The massive quantities of inorganic fertilizers cause different environmental hazards which are as follows:

(i) Soil nutrient holding capacity:

The massive quantities of inorganic fertilizers affect the soil nutrient holding capacity.

(ii) Eutrophication:

The high solubility of fertilizers also degrade ecosystem through eutrophication (means an increase in chemical nutrients typically compounds containing nitrogen or phosphorus in an ecosystem).

(iii)Emission of greenhouse gas:

Storage and application of some nitrogen fertilizers may cause emission of greenhouse gas, nitrous oxide

(iv)Soil acidity:

Ammonia gas (NH_3) may be emitted from applied inorganic fertilizers. This extra ammonia can also increase soil acidity.

(v) Pest Problems:

Excessive nitrogen fertilizers can lead to pest problem by increasing their reproduction rate.

(vi)Nutrient Balance:

It is recommended that nutrient content of the soil and nutrient requirement of crop are carefully balanced with application of inorganic fertilizers.

Hazards occur due to excessive use of organic fertilizers. Excessive amount of organic fertilizers cause environmental problems due to nitrate leaching or run off of soluble organic compounds.

Q.8. Describe the sources, energy values and functions of carbohydrates, proteins and fats in detail?

Ans. Carbohydrates

Carbohydrates are the basic source of energy for all animals.

(i) Sources

Plants synthesize carbohydrates during photosynthesis. Animals get carbohydrates from their environment.

Humans get carbohydrates from food like bread, pastas, beans, potatoes, bran, rice and cereals.

(ii) Energy value

About half to 2/3 of total calories, every animal consumes daily are from carbohydrates. Carbohydrates contain 04 kilocalories per gram.

(iii)Functions

Carbohydrates is common source of energy. e.g. glucose.

(iv)Other useful carbohydrates

Other useful carbohydrates are maltose, lactose, sucrose and starch.

Proteins

(i) Introduction

"Proteins are composed of amino acids."

(i) Sources

Meat, eggs, grains, legumes and dairy products such as milk and cheese are dietary sources of proteins.

Energy level

One gram of proteins contains 04 kilocalories of energy.

Functions

(i) Proteins can also be used for gaining energy.
(ii) Proteins are essential components of muscles, ligaments and tendons.
(iii) They are also major components of cytoplasm, membranes and organelles.
(iv) Proteins play role as "enzymes".
(v) Proteins are used for growth

Lipids **(Lahore board 2012 G II) (short questions)**

"Lipids present in food are composed of fatty acids bonded to glycerol."

Types of fatty acids:

Fatty acids of lipids are;
(i) Saturated fatty acids.
(ii) Un-saturated fatty acids.

(i) Saturated fatty acids

Saturated fatty acids have all of their carbon atoms bonded to hydrogen atoms.

(ii) Unsaturated fatty acids

Un-saturated fatty acids have some of their carbon atoms double-bonded in place of hydrogen atoms.

Lipids containing Saturated fatty acids are solid at room temperature.

Lipids containing un-saturated fatty acids are liquid at room temperature.

Example:

(i) Butter contains 70% saturated and 30% unsaturated fatty acids.

(ii) Sunflower oil contains 75% unsaturated and 25% saturated fatty acids.

(iii)Sources

Milk, butter, cheese, eggs, mutton, fish, mustard seeds, coconut and dry fruit etc.

(iv)Energy Level

One gram of lipids contains 09 kilocalories of energy.

(v) **Functions**

(i) Lipids are also useful energy source.

(ii) It is used to form membranes, sheaths of neurons and hormones.

Q.9. What are minerals? Discuss their roles in human body.

Ans. Minerals in food

Definition: "Minerals are inorganic elements that originate in Earth and cannot be made in the body."

Role: They play important roles in various body functions and are necessary to maintain health.

Sources: Most minerals in human diet come directly from plants and water or indirectly from animal foods.

Types:

(i) **Major minerals:** are required in amount of 100mg or more per day.

(ii) **Trace minerals:** are required in amount less than 100 mg per day.

<table>
<tr><th colspan="3">Table 8.2: Important minerals in human diet and their roles</th></tr>
<tr><th>Minerals</th><th colspan="2">Role in body</th></tr>
<tr><td>Major minerals</td><td colspan="2"></td></tr>
<tr><td>Sodium</td><td>Fluid balance in the body
Helps in absorption of other nutrients</td><td rowspan="3">Important for muscle contraction, nerve impulse transmission, heart function, and blood pressure</td></tr>
<tr><td>Potassium</td><td>Fluid balance in the body
Acts as cofactor for enzymes</td></tr>
<tr><td>Chloride</td><td>Fluid balance in the body
Component of hydrochloric acid</td></tr>
<tr><td>Calcium</td><td colspan="2">Development and maintenance of bones and teeth
Blood clotting</td></tr>
<tr><td>Magnesium & Phosphorus</td><td colspan="2">Development and maintenance of bones and teeth</td></tr>
<tr><td>Trace minerals</td><td colspan="2"></td></tr>
<tr><td>Iron</td><td>Oxygen transport and storage</td><td rowspan="2">Act as enzyme cofactors
Support immune function</td></tr>
<tr><td>Zinc</td><td>Aids insulin action
Helps in growth and reproduction</td></tr>
<tr><td>Copper</td><td colspan="2">Acts as enzyme cofactor</td></tr>
<tr><td>Chromium</td><td colspan="2">Helps in insulin action</td></tr>
<tr><td>Fluoride</td><td colspan="2">Stabilizes bone mineral and hardens tooth enamel</td></tr>
<tr><td>Iodine</td><td colspan="2">Essential for normal thyroid function</td></tr>
</table>

Q.10. Describe the role of calcium and iron in our diet.

Ans. Calcium

(i) Role of calcium **(Lahore board 2012 G II) (Lahore board 2012 G I)**

(i) Calcium is essential for the development and maintenance of bones and teeth.

(ii) It is also needed for maintaining cell membranes and connective tissues.

(iii) It is used for activation of several enzymes.

(iv) Calcium also aids in blood clotting.

(v) Good calcium nutrition, along with low salt and high potassium intake, prevents from hypertension and kidney stones.

(ii) Sources:-

Humans get calcium from milk, cheese, egg Yolk , beans , nuts, cabbage etc.

Effects of Calcium Deficiency

(i) Spontaneous discharge of nerves impulses which may result in tetany.

(ii) Bones also become soft, blood clots slowly and wounds heal slowly.

Iron:

(i) **Role of Iron** **(Lahore board 2012 G II)**

(i) Iron plays a major role in oxygen transport and storage.

(ii) It is a component of haemoglobin in red blood cells and myoglobin in muscle cells.

(iii) Cellular energy production also requires iron. It acts as cofactor for many enzymes of cellular respiration.

(iv) Iron also supports immune function.

(ii) **Sources:**

Humans get iron from red meat, egg yolk, whole wheat, fish, spinach, mustard etc.

(iii)**Effects of Iron deficiency**

Iron deficiency causes anaemia.

Q.11. Define vitamins. Describe different types of Vitamins.

Ans. Definition

Vitamins are chemical compounds that are required in low amounts but are essential for normal growth and metabolism.

Types

Vitamins may be divided into two groups:

(i) Fat-soluble Vitamins **(Lahore board 2012 G II) (short questions)**

These are Vitamins A, D, E and K.

Fat-soluble vitamins are much less excreted from the body as compared to water-soluble vitamins. This means that levels of water-soluble vitamins in the body can decrease more quickly, leading to vitamin deficiency.

(ii) Water soluble Vitamins

These are vitamins B and C.

Cooking or heating destroys the water soluble vitamins more readily than the fat-soluble vitamins.

Types

(i) Vitamin A

(i) Identification

Vitamin A was the first fat soluble vitamin identified in 1913.

(ii) Functions

(i) Formation of Rhodopsin

Vitamin A combines with a protein called opsin to form rhodopsin in the rod cells of the retina of eye. Sometimes, there is lack of vitamin, so there is less rhodopsin. It makes difficult to see in dim light.

(ii) Cell Differentiation

It is involved in normal cell differentiation. The process through which embryonic cells transform into mature cells with highly specific functions is called differentiation.

(iii) Bone Growth

Vitamin A supports bone growth.

(iv) Immune Function

It is essential for immune function. Deficiency of Vitamin A causes decreased resistance to infections.

(v) Sources

Humans get Vitamin A from leafy vegetables (Spinach, carrots), yellow/orange fruits (mango), liver, fish, egg, milk, butter, etc.

Effects of Vitamin A Deficiency

(i) Blindness

Deficiency of Vitamin A causes blindness in children worldwide. One of the symptoms of Vitamin-A deficiency is night blindness. It is a temporary condition. But if left untreated it can cause permanent blindness.

(ii) Rough Hair and Skin

Hair follicles are plugged with keratin due to deficiency of Vitamin A. It makes the hair bumpy and rough. It gives dry texture to skin.

(ii) Vitamin C (Ascorbic Acid)

(i) Identification

It is a water soluble Vitamin.

(ii) Functions

(i) Participation in Reactions

Vitamin C participates in many reactions.

(ii) Formation of a Fibrous Protein Collagen

Vitamin C is needed to form collagen (a fibrous protein). Collagen gives strength to connective tissues. Collagen is also needed for the healing of wounds.

(iii) White blood Cells

White blood cells need Vitamin C. It enables the immune system to function properly.

(iv) Sources

We get Vitamin C from citrus fruits e.g, oranges, Lemons, and grape fruit), Leafy green Vegetables, beef liver etc.

Effects of Vitamin C Deficiency

(i) Scurvy **(Lahore board 2011 G II)**

Its deficiency causes connective tissue changes throughout the body. This disease known as scurvy. In this condition, synthesized collagen is too unstable.

Symptoms of scurvy are muscle and joint pain, swollen and bleeding gums, slow wounds healing and dry skin.

Vitamin D

(i) Identification

It is fat soluble Vitamin.

(ii) Functions

(i) Absorption of Minerals from Intestine

It helps to regulate levels of Calcium and Phosphorous in blood. It increases absorption of these minerals from the intestine. It also increases their deposition in bones.

(ii) Sources **(Lahore board 2012 G I)**

Vitamin D is mainly found in fish liver oil, milk, ghee and butter etc. It is also synthesized by the skin when ultraviolet (UV) radiations from the sun is used to convert a compound into vitamin D.

Effects of Vitamin D Deficiency

(i) Rickets: Deficiency of vitamin D affects bones. In children, vitamin D deficiency leads to rickets, a condition in which bones weaken and bow under pressure.

(ii) Osteomalacia: In adults, vitamin D deficiency causes osteomalacia or "Soft bones", increasing the risk for fractures in bones.

Table 8.3: Functions, deficiencies and sources of important vitamins

Vitamin	Sources	Functions	Deficiency symptoms
Vitamin A	Leafy vegetables (spinach, carrots) Yellow fruits Fish Liver Egg, milk and butter	Vision in dim light Cell differentiation Growth Immunity	Poor growth Blindness Dry skin

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(ii) Soluble fibre

(i) Insoluble fibres

These travel through the small intestine quickly.

Sources

Wheat bran, cereals and skin of many fruits and vegetables consist of insoluble fibres.

(ii) Soluble fibres

These fibres break down as these pass through the digestive track.

Sources

Oat, beans, barley and many fruits and vegetables:

Important functions of fibres

(i) **Prevents from constipation**

Fibre prevents and relieves constipation by stimulating the contraction of intestinal muscles,

(ii) **Lowering blood cholesterol**

Soluble fibre helps in lowering the blood cholesterol.

(iii) **Lowering blood sugar level**

Soluble fibre helps in lowering blood sugar levels.

(iv) **Exposure to carcinogens**

Insoluble fibre speeds up the movement of carcinogens (cancer causing agents) from intestine.

(v) **Use of fibre supplements**

Fibre supplements (such as ispaghol husk) should be used only with a physician's recommendations. Taken properly, these supplements may help in preventing constipation and in lowering cholesterol levels

Q.13. What is balanced diet? How would you relate it with age, sex and activity?

Ans. Balanced Diet

Humans require various types of nutrients in appropriate amount in their diet.

Diet is the food on which an individual lives.

Definition

"The diet, which contains all the essential nutrients like carbohydrates, fats, proteins, minerals, vitamins in the correct proportion for the normal growth and development of the body is called a balanced diet."

The following chart shows some of common food and %age of carbohydrates, lipids and proteins in each of them.

Food	Carbohydrates	Lipids	Proteins
Bread	52%	03%	09%
Rice	23%	0.1%	2.2%
Potato	19%	0.1%	02%

Apple	12.8%	0.5%	0.3%
Eggs	0.7%	12%	13%
Milk	04%	04%	03%
Butter	0.4%	81%	0.6%
Chicken	0	11%	20%

Relation of balanced diet with age, gender and activity

Relation with age: During growth period of the body, there is higher metabolic rate in body cells and body needs a balanced diet that contains more energy.

Daily requirements of Proteins

Adults: need less proteins per kg body weight but a growing boy or girl needs more proteins per kg weight.

Children: need more calcium and iron for their growing bones and red blood cells.

Relation of balanced diet with Gender: Gender has an impact on the requirements of a balanced diet.

Women: have comparatively less metabolic rate than the men of same age and weight.

Table 8.4: Estimated energy requirements (in Kilocalories) according to age, gender and activity

Gender	Age (years)	Activity Level		
		Sedentary	Moderately active	Active
Child Male/Female	2-3	1,000	1,000-1,400	1,000-1,400
Female	4-8	1,200	1,400-1,600	1,400-1,800
	9-13	1,600	1,600-2,000	1,800-2,200
	14-18	1,800	2,000	2,400
	19-30	2,000	2,000-2,200	2,400
	31-50	1,800	2,000	2,200
	50+	1,600	1,800	2,000-2,200
Male	4-8	1,400	1,400-1,600	1,600-2,000
	9-13	1,800	1,800-2,200	2,000-2,600
	14-18	2,200	2,400-2,800	2,800-3,200
	19-30	2,400	2,600-2,800	3,000
	31-50	2,200	2,400-2,600	2,800-3,000
	50+	2,000	2,200-2,400	2,400-2,800

Men need a balanced diet that provides comparatively more energy than the women require.

Relation of balance diet with activity:

Different people have different lifestyle and varied nature of work. A man with sedentary habits does not require as much energy as the man who is on his feet for most of the day.

Q.14. Define malnutrition. Describe its importance and forms?

Ans. Definition

Problems related to nutrition are grouped as malnutrition. The condition caused by an improper or insufficient diet is called malnutrition.

Types

It has two types:

(i) Undernutrition

Malnutrition most oftenly refers to undernutrition. It is caused due to inadequate consumption, poor absorption or excessive loss of nutrients.

(ii) Overnutrition

Malnutrition also includes overnutrition resulting from overeating or excessive intake of specific nutrients.

Harms

(i) Malnutrition weakens the immune system.

(ii) It impairs physical and mental health.

(iii) It slows down thinking and stunts growth.

(iv) It effects foetal (embryo) development.

(v) Often it leads to infections diseases.

(vi) According to UNICEF, malnutrition contributes to the deaths of more than 6 million children (under age five) each year.

Major Forms of Malnutrition

(i) Protein-Energy Malnutrition (PEM):

Protein energy malnutrition refers to inadequate availability or absorption of energy and proteins in the body."

It is the leading cause of death in children in developing countries.

PEM may lead to diseases such as;

(i) Kwashiorkor.

(ii) Marasmus

(i) KWASHIORKOR

Introduction

(a) (b)

Figure 8.1: Children suffering form (a) Kwashiorkor (b) Marasmus

In kwashiorkor, children may grow to normal height but are abnormally thin.

Cause: It is due to protein deficiency.

Age: Kwashiorkor can develop at any time during a child is growing but more common at age of about 12 months when breastfeeding is discontinued.

(ii) MARASMUS

Introduction

Marasmus patients usually lose all their body fat and muscle strength and aquire a skeletal appearance. Children with marasmus show poor growth and look small for their age.

Cause: It is due to protein deficiency.

Age: Marasmus usually develops between age of six month and one year in children.

(ii) Mineral Deficiency disease (MDD)

Diseases resulting from deficiency of a mineral are relatively rare among humans Some are given below;

(i) Goiter

Goiter is a condition in which thyroid gland becomes enlarged and it results in swelling in neck.

Cause: Goiter is caused by an insufficient amount of "Iodine" in diet.

Iodine is used by thyroid gland to produce hormones that control the body's normal functioning and growth.

(ii) ANEMIA (most common of all mineral deficiency diseases)

"The term anemia literally means "a lack of blood".

Causes: The condition is caused when number of red blood cells reduced to a level lower than normal.

Explanation

Haemoglobin molecule contains a single atom of iron at its centre. If body fails to receive sufficient amount of iron, an adequate number of haemoglobin will not be formed. So, there are not enough functioning red blood cells. A person becomes weak and there is shortage of oxygen supply to body's cells.

(ii) Over intake of Nutrients (OIN)

Over intake of nutrients (OIN) is a form of malnutrition in which more nutrients are taken than the amount required for normal growth, development and metabolism."

The effects of over-intake of nutrients are usually intensified when there is reduction in daily physical activity (decline in energy expenditure)

High intake of carbohydrates and fats leads to;

(i) Obesity

(ii) Diabetes

(iii) Cardiovascular problems

High dose of vitamin A causes;

(i) Loss of appetite.

(ii) Liver problems.

Excess dose of vitamin D causes;

Deposition of calcium in various tissues.

Q.15. Describe effects of Malnutrition.

Ans. Effects of Malnutrition

(i) **Starvation:** Starvation is a severe reduction in nutrient and energy intake. In humans, prolonged starvation causes permanent organ damage. It may result in death.

(ii) Heart Diseases

It is one of the causes of malnutrition. Heart problems occur in those people who take unbalanced diet. Fatty foods increase blood cholesterol level. It obstructs the blood vessels leading to heart diseases.

(iii)Constipation

People do not schedule their meals. This irregularity cause many health problems like constipation.

(iv)Obesity

"Obesity means becoming over-weight and it may also be due to malnutrition."

People who take food that contains energy more than their requirement and do very little physical work can become obese.

Obesity is known as mother-disease and may lead to heart problems, hypertension, diabetes etc.

(v) The World Health Organization (WHO) estimates that, within the next few years, diseases due to malnutrition will become the principal global causes of mortality.

(vi) According to the Food and Agriculture Organization of the United Nations, more than 25,000 people die of starvation every day. On average, every five seconds a child dies from starvation.

Q.16. Describe famine as the major cause of malnutrition.

Ans. Introduction

Famine is the lack of enough food to feed all the people living in an area.

Most terrible Famines of the 20th Century are the:

(i) The Ethiopian Famine (1983-1985)

(ii) The North Korean Famine (1990s)

Causes

(i) Unequal distribution of food

Due to political and administrative problems the food is not equally distributed to the different regions of the world. The result is that there is always surplus food in countries like America, UK and Canada etc and at the same time people have nothing to eat in countries like Ethiopia, Somalia etc.

(ii) Drought

(i) Definition

A drought is a period of time when there is not enough water to support agricultural and human needs.

(ii) Cause

It is usually due to an extended period of below normal rainfall.

(iii)Effects

It decreases or even stops the crop yields resulting in famine.

(iii)Flooding

(i) Definition

It occurs due to more than normal rainfall or due to weak water distribution system. Rivers and canals overflow their banks and destroy the soil quality of agricultural lands.

(ii) Effect

It becomes impossible to grow crops immediately after flooding.

(iv)Increasing population

In the over populated regions of the world, large populations overuse natural resources to grow maximum food in order to meet the problems of food shortage. It leads to dry and infertile lands and depletion of resources and famines result.

Q.17. Describe digestion and its phases.

Ans. Definition

Digestion is the process in which large and non-diffusible molecules of food are converted into smaller and diffusible molecules that can cross the membranes.

Phases of Digestion

The nutrition in humans comprises of the following phases.

1. Ingestion

The process of taking in food.

2. Digestion

The process of breaking up complex substances into simpler substances.

3. Absorption

Diffusion of digested food into blood and lymph.

4. Assimilation

Conversion or incorporation of absorbed simple food into the complex substances constituting the body.

5. Defecation

Elimination of undigested food from the body.

Q.18. Explain various parts of digestive system and process of digestion and absorption in detail?

Ans. Explanation

Products of digestion

Proteins are digested into amino acids, polysaccharides into simple sugars (e.g. glucose) and lipids into fatty acids and glycerol.

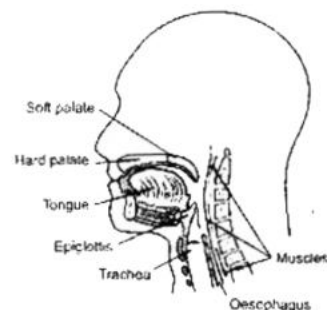



Figure 8.2: Parts of oral cavity

Alimentary Canal

The human digestive system consists of a long tube that extends from the mouth to the anus. This tube is called alimentary canal.

Main structures of Alimentary Canal

(i) Oral cavity
(ii) Pharynx
(iii) Oesophagus
(iv) Stomach
(v) Small intestine
(vi) Large intestine
(vii) Glands associated with alimentary canal.
(a)liver (b) pancreas (c) three pairs of salivary glands.

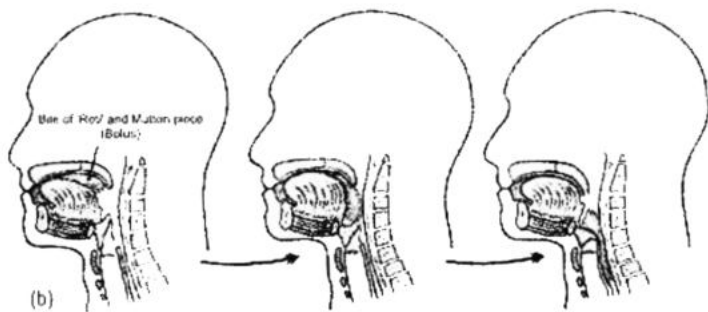



Figure 8.3: Steps in swallowing

(i) Oral cavity

Definition

"Oral Cavity is the space behind mouth and has many important functions.

Functions of oral cavity:

(i) Food Selection: When food enters the oral cavity it is tasted and felt. Here food is selected or rejected due to taste, hard object or dirt. Smell and vision also help in selection.

(ii) Grinding of food: The second function of oral cavity is the grinding of food by teeth. It is known as chewing or mastication. It is useful because oesophagus can pass only small pieces through it because enzymes cannot act on large pieces of food.

(iii) Lubrication of food: The third function of the oral cavity is lubrication of food by mixing saliva secreted by three pairs of salivary glands in oral cavity. Saliva has two main functions.

(i) Adds water and mucous to the food.
(ii) Partial digestion of starch by saliva which contains an enzyme salivary amylase.

(iv)Chemical digestion:

Saliva contains an enzyme salivary amylase which aids in the digestion of starch partially. After chewing, lubrication and partial digestion, the pieces of bread and mutton are rolled up by the tongue into small, slippery, spherical mass called bolus.

(v) Swallowing of the bolus

Then food is swallowed in the form of bolus and pushed in oesophagus through the Pharynx.

(ii) Pharynx and oesophagus:

Peristalsis:

The bolus is swallowed and then pushed down by the movement called peristalsis.

Definition

It is defined as the waves of contraction and relaxation in the smooth muscles of the walls of alimentary canal.

Figure 8.4: Peristalsis

Entry of bolus into Pharynx

During swallowing, the bolus is pushed to the back of mouth by the tongue. The soft palate moves upward and to rear in order to close the opening of the nasal cavity.

Adaptations to Prevent the bolus in Trachea

Pharynx has adaptations to prevent the entry of bolus in trachea. During swallowing, larynx moves upward and forces the epiglottis into horizontal position. Thus respiratory track is closed. The beginning of the swallowing action is voluntary, but once food reaches the back of the mouth, swallowing becomes automatic.

(iii) Oesophagus

After being swallowed, the food enters the tube called the oesophagus, which connects the pharynx to stomach. Neither pharynx nor the oesophagus contributes to digestion and the previous digestive actions of saliva continue.

(iv) Digestion of food in stomach **(Lahore board 2011 G I,II & 2012 G I)**

Definition and Location

Stomach is a dilated part of the alimentary canal. It is J shaped, located in the left part of abdomen, just beneath the diaphragm.

Structure

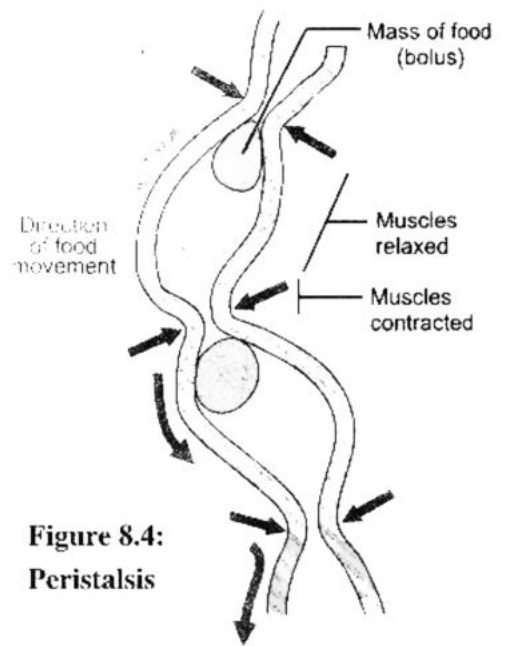
Stomach has two main portions, Cardiac and Pyloric portions.

The cardiac portion is present immediately after oesophagus and the pyloric portion is located beneath the cardiac portion.

Sphincters

Stomach has two sphincters (opening which are guarded by muscles). The cardiac sphincter is between stomach and oesophagus. Pyloric sphincter is between stomach and small intestine.

Entry of food into stomach

The bolus enters the stomach from oesophagus through the cardiac sphincter.

Digestion in Stomach

(i) When food enters into the stomach the gastric juice is secreted by gastric glands found in the stomach wall. It is composed of

(i) Mucous

(ii) Hydrochloric acid

(iii) Protein digesting enzyme pepsinogen.

(ii) Hydrochloric acid converts the inactive enzyme pepsinogen into active form called pepsin. HCl also kills microorganisms present in food.

(iii) Pepsin partially digests the protein portion of the food into polypeptides and shorter peptide chains.

(iv) In stomach food is further broken apart through a process called churning. The walls of stomach contract and relax and these movements help in thorough mixing of the gastric juice and food.

(v) The churning action also produces heat which helps to melt the lipid contents of the food.

(vi) The starch and proteins in our food have been partially digested and food has been converted into a soup like mixture called chyme.

Figure 8.5: Structure of stomach

(vii) After it, the pyloric sphincter allows a little mass of chyme to enter duodenum.

(v)Digestion in small intestine

Small intestine is divided into 3 parts

(i) Duodenum

(ii) Jejunum

(iii) Ileum

(i) **Duodenum:** comprises of first 10 inches (25 cm) of the small intestine and it is the part of alimentary canal where most of the digestive process occurs. Here food is mixed with three different secretions.

(i) Bile from liver helps in the fat digestion, through emulsification.

(ii) Pancreatic juice from pancreas contains enzymes trypsin, pancreatic amylase and lipase, which digest proteins, carbohydrates and lipids respectively.

(iii) Intestinal juice from intestine walls contains many enzymes for complete digestion of all kinds of food.

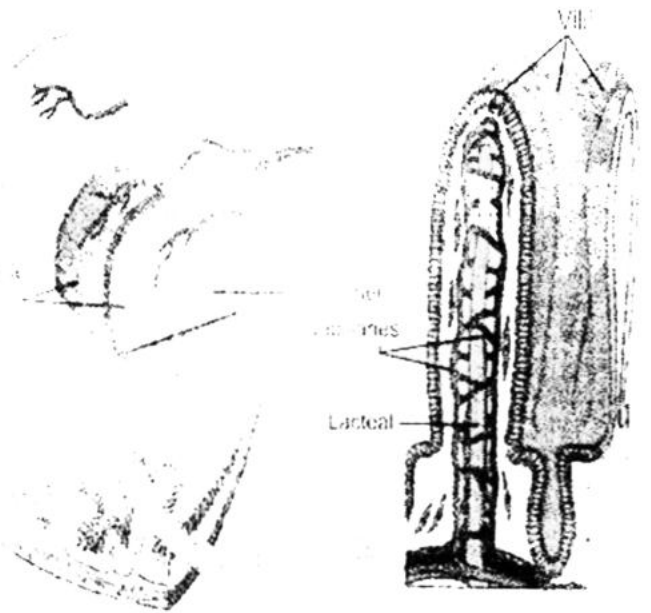
(ii) Jejunum: Next to the duodenum is 2.4 meters long jejunum. It is concerned with rest of the digestion of Proteins, carbohydrates and lipids of our bite.

(iii)Ileum: Last 3.5 meters long part of the small intestine is Ileum. It is concerned with the absorption of digested food.

Absorption of food in small intestine:

(i) Villi

8.6:

There are circular folds in the inner wall of the ileum. These folds have numerous finger like projections called villi (singular: villus). Villi increase the surface area of the inner walls and it helps a lot in the absorption of digested food. Each villus is richly supplied with blood capillaries and a vessel of lymphatic system called lacteal. The wall of villus is only single cell thick.

(ii) Absorption of sugar and amino acids

The digested molecules i.e. simple sugars and amino acids are absorbed from the intestine into the blood capillaries present in villi. Blood carries them away from the small intestine via the hepatic portal vein and goes to the liver for filtering, removal of toxins and nutrients processing.

(iii)Absorption of fatty acids and glycerol

Fatty acids and glycerol are absorbed into the lymphatic vessel (lacteal) present in villi, which carries them to the main lymphatic duct, from where they enter in the blood stream.

(vi) Large intestine-absorption of water and defecation

After the digested products of our bite have been absorbed in blood, the remaining mass enters the large intestine.

Parts of large intestine:

It has 3 parts. i. Caecum ii. Colon iii. Rectum

(i) A caecum or pouch that forms the T-junction with small intestine.

(ii) The colon: From colon, water is absorbed into the blood.

Faeces: As the water is absorbed, the solid remains of food are called faeces. It contains

(i) undigested material

(ii) a large no of bacteria

(iii) Sloughed off cells of alimentary canal.

(iv) Bile pigments and

(v) Water as a part of the faeces.

(iii) Rectum: Last part of the large intestine is rectum where faeces are temporarily stored.

Anus: Rectum opens out through a pore called anus.

Defecation

When rectum is filled with faeces, it gives rise to a reflex and anus is opened for defecation.

This reflex is consciously inhibited in adults but in infants it is controlled involuntarily. During growth, the child learns to bring this reflex under voluntary control.

Q.19. Describe the structure and functions of liver?

Ans. Introduction

A dark reddish organ, the liver is the largest gland of the body.

(i) Weight and size

In an adult human, it weighs about 1.5 kg and is the size of a football.

(ii) Location

Liver lies beneath the diaphragm on the right side of the abdomen.

Figure 8.7: Liver and Associated organs

(iii) Structure

It consists of a larger right lobe and a smaller left lobe.

(iv) Gall Bladder

A pear shaped greenish yellow sac, the gall bladder lies along the right lobe of liver on the ventral side.

Fig: 8.8 Human Digestive System

(v) Function of digestion

Liver secretes bile which is stored in the gall bladder.

Emulsification

Bile is released in duodenum through bile duct. Bile has bile salts which keep lipid droplets separate from one another, a process called emulsification.

(vi) Other Functions

Beside digestion, liver carries out a number of other functions. Some of which are summarized here:-

(i) Deamination

Removes amino groups from amino acids

(ii) Formation of urea

Converts ammonia to a less toxic form i.e., urea

(iii) Destruction of red blood cells

Destroys the old red blood cells.

(vi) Formation of blood clotting proteins

Manufactures blood clotting proteins called fibrinogen.

(ii) Interconversion of glucose

Converts glucose into glycogen and, when required, breaks glycogen into glucose.

(vi) Production of cholesterol

Converts carbohydrates and proteins into lipids and produces cholesterol.

(vii) Production of heat

Produces heat to maintain body temperature.

(viii) Storage of fate soluble vitamins and minerals

Stores fat-soluble vitamins (A,D,E, and K) and mineral ions, such as iron.

Q.20. Briefly give the signs and symptoms, causes, treatments and preventions of Diarrhoea, constipation and ulcer?

Ans. Diarrhoea

Introduction: It is a condition in which the sufferer has frequent watery, loose bowel movements.

Sign and symptoms

This condition may be accompanied by;

Abdominal pain

Nausea

Vomiting

Causes: It occurs when required water is not absorbed in blood from colon.

The main cause of diarrhoea include;

Lack of adequate safe water

Virus and bacteria may cause it.

Treatment

In malnourished individuals, diarrhoea can lead to severe dehydration and can become life threatening.

Treatment for diarrhoea involves consuming adequate amounts of water to replace loss, preferably mixed with essential salts and some amount of nutrients.

Antibiotics may be required if diarrhoea is due to bacterial infection.

Prevention: Take clean water and essential salts.

Eat regularly.

Take hygienic measures.

Constipation: Constipation is a condition where a person experiences hard faeces that are dificult to eliminate.

Causes: The main causes of constipation are:

(i) Hardening of faeces due to excessive absorption of water through colon.

(i) Insufficient intake of dietary fibre.

(ii) Dehydration

iv) Use of medicine (e.g. those containing iron, calcium and aluminum)

v) Tumours in rectum or anus.

Treatment: Treatment of constipation is;

(i) With a change in dietary and exercise habits.

(ii) Laxative (e.g. paraffin) may be used in some cases.

Prevention:

(i) Constipation is easier to prevent than treat.

(ii) Take required quantities of water and dietary fibres.

Ulcer

Definition

Ulcer (peptic ulcer) is a sore in gut lining.

Types

(i) Ulcer of stomach is called "gastric ulcer".

(ii) Ulcer of duodenum is called "duodenal ulcer"

(iii) Ulcer of oesophagus is called "esophageal Ulcer."

Causes

(i) Breakdown of tissue by acidic gastric juice.

(ii) Infection.

(iii) Long term use of anti-inflammatory medicine (e.g. aspirin).

(iv) Smoking.

(v) Drinking coffee, colas

(vi) Eating spicy food.

Sign and symptoms

(i) Abdominal burning after meals.

(ii) Abdominal pain.

(iii) Rush of saliva after an episode of regurgitation.

(iv) Nausea

(v) Loss of appetite.

(vi) Loss of weight.

Treatment : Treatment of ulcer is with medicine, containing (alkaline composition).

Prevention : Avoid

i) Spicy food ii) Smoking

Multiple Choice Questions

1. What is the primary nutrient that provides quick useable energy for the body?
   (a) Carbohydrates (b) Proteins
   (c) Lipids (d) Nucleic acids
2. The wavelike movement of muscle that pushes food through the digestive system is called;
   (a) Chemical digestion
   (b) Emulsification
   (c) Absorption
   (d) Peristalsis
3. Micronutrients of plants are;
   (a) Available in the soil in small amounts
   (b) Required by plants in small amounts
   (c) Small molecules required by plants
   (d) Useful, but not required by plants
4. Which of the following does not occur in the oral cavity?
   (a) Lubrication of the food
   (b) Beginning of protein digestion
   (c) Breaking the food into small fragments
   (d) All of the above do occur in the oral cavity
5. Where are the villi found?
   (a) Esophagus
   (b) Stomach
   (c) Small intestine
   (d) Large intestine
6. Ulcers occur in the;
   (a) Stomach (b) Duodenum
   (c) Esophagus (d) All
7. Which group of enzymes breaks up starches and other carbohydrates?
   (a) Proteases (b) Lipases
   (c) Amylases (d) Duodenum
8. The pancreas produces digestive enzymes and releases them into the;
   (a) Colon (b) Gallbladder
   (c) Liver (d) Duodenum
9. In the stomach, pepsinogen is converted into;
   (a) Pepsin (b) Bicarbonate
   (c) HCl (d) Gastrin
10. The hepatic portal vein carries blood from the _________ to the ______.
   (a) Small intestines, liver
   (b) Small intestines, heart
   (c) Liver, heart
   (d) Small intestines, colon
11. Which of the following is not a function of the liver?
   (a) Converts glucose to glycogen
   (b) Converts glycogen to glucose
   (c) Detoxifies poisonous substances
   (d) Produces digestives enzymes
12. The diseases of Kwashiorkor and marasmus may be due to;
   (a) Mineral deficiency
   (b) Over-intake of nutrients
   (c) Protein-energy malnutrition
   (d) Milk and cheese
13. Which food group is our body's best source of energy?
   (a) Meat Group
   (b) Fats, oils and sweets
   (c) Breads and cereals
   (d) Milk and cheese

14. What may be the reason that children need more calcium and iron?
(a) Both calcium and iron for bones
(b) Both calcium and iron for blood
(c) Calcium for blood and iron for bones
(d) Calcium for bones and iron for blood

15. The process of breaking down large droplets of fat into small droplets of fat is called:
(a) Emulsification (b) Absorption
(c) peristalsis (d) Digestion

16. Which one of the following macro nutrient is the part of chlorophyll?
(a) Calcium (b) Magnesium
(c) Sulphur (d) Iron

17. Which of the following is not a macronutrient ?
(a) Nitrogen (b) Oxygen
(c) Carbon (d) Nickel

18. Chemically synthesized urea is a ________fertilizer.
(a) Organic (b) Inorganic
(c) Both (d) None

19. Good calcium along with low salt and high potassium intake prevents from:
(a) Hypertension (b) Kidney stone
(c) a and b (d) None

20. According to (UNICEF), how many children of under age five died by malnutrition?
(a) 4 million (b) 5 million
(c) 6 million (d) None

21. In adult human, the esophagus is about_________ long.
(a) 25 cm (b) 25 mm
(c) 25 m (d) 25 ft

22. Inactive pepsinogen in gastric juice require _______ for its activated form (pepsin).
(a) H_2SO_4 (b) HCl
(c) HNO_3 (d) Saliva

23. Many bacteria in colon produce vitamin ______ necessary for coagulation of blood.
(a) A (b) K
(c) C (d) D

24. The secretion of liver is:
(a) Pepsin (b) Bile
(c) Rennin (d) Lipase

25. Breaking of large molecules of fats into small droplets is called:
(a) Emulsification (b) Digestion
(c) Assimilation (d) Egestion

26. Following are not fat-soluble vitamins.
(a) A and D (b) E and K
(c) B and C (d) D and E

27. Rickets develops due to deficiency of _____ vitamin.
(a) B (b) A
(c) D (d) C

(Lahore board 2011 G I)

28. Saliva is alkaline and contains an enzyme:
(a) Pepsin (b) Rennin
(c) Ptyalin (d) Amylase

29. Nitrogen is present in:
(a) Carbohydrates (b) Protein
(c) Nucleic acid (d) Lipids

30. In which group of the following is present Mg?
(a) Chlorophyll (b) Cytochrome
(c) Haemoglobin
(d) None of the above

31. which of the following is not the process included in the digestion?

(a) conversion of amino acid into protein
(b) Conversion of protein into amino acid
(c) Conversion of glucose into starch
(d) Conversion of fatty acid into lipids

32. The reason why digestion take place is?
(a) Animals need food particles in the form of smaller molecules
(b) The large food molecule cannot pass through their membrane
(c) The small food molecules increase their efficiency
(d) None of the above

33. The function of the mucous of the salivary gland is to:
(a) Digest the food
(b) Make the food chew efficient
(c) Transport the food
(d) Break the food

34. Which of the following is not the function of saliva?
(a) Digestion of food
(b) Lubrication of food
(c) Stabilization of PH
(d) Absorption of food

35. The Amylase acts on:
(a) Protein (b) Starch
(c) glucose (d) Lipids

36. Which of the following steps does not take place during act of swallowing?
(a) Moving of tongue up and down
(b) Upward movement of the larynx
(c) Opening of the glottis
(d) the movement of epiglottis in horizontal direction

37. The function of the pepsin to convert the protein into:
(a) Amino acid (b) Peptones
(c) Dipeptides
(d) None of the above

38. Gastrin is an:
(a) Enzyme of gastric juice
(b) It is a part of the stomach
(c) It stimulate the secretion of gastric juice
(d) It promotes the digestion of proteins

39. The length of duodenum is:
(a) 15 - 20 cm (b) 20 - 25 cm
(c) 25 – 35 cm
(d) None of the above

40. Which of the following enzymes act on fats:
(a) Amylase (b) Lipase
(c) Trypsin (d) None of these

41. Most of the fatty acids are absorbed by:
(a) Epithelium of the villi
(b) Lacteal of the villi
(c) Blood capillaries of the villi
(d) None of the above

42. Most of the water is absorbed by:
(a) Oral cavity (b) Stomach
(c) Small intestine
(d) Large intestine

43. The largest gland of human body is:
(a) Pancreas (b) Thyroid
(c) Liver (d) Parathhyroid
(Lahore board 2011 G II)

44. Bread contains amount of carbohydrates:
(a) 40% (b) 30%
(c) 52% (d) 70%
(Lahore board 2011 G II)

Answers

1.	**a**	11.	**d**	21.	**a**	31.	**b**	41.	**b**		
2.	**d**	12.	**c**	22.	**b**	32.	**b**	42.	**d**		
3.	**b**	13.	**c**	23.	**b**	33.	**b**	43	**c**		
4.	**b**	14.	**d**	24.	**b**	34.	**d**	44	**c**		
5.	**c**	15.	**a**	25.	**a**	35.	**b**				
6.	**d**	16.	**b**	26.	**c**	36.	**c**				
7.	**c**	17.	**d**	27.	**c**	37.	**b**				
8.	**d**	18.	**b**	28.	**d**	38.	**c**				
9.	**a**	19.	**c**	29.	**b**	39.	**b**				
10	**a**	20.	**c**	30.	**a**	40.	**b**				

Short Questions

Q.1. What is amylase?

Ans. Saliva contains an enzyme salivary amylase, which aids in the partial digestion of starch.

Q.2. What is anaemia?

Ans. The term anaemia literally means "a lack of blood". The condition is caused when number of red blood cells are reduced to a level lower than the normal, caused by deficiency of iron.

Q.3. What is appendix?

Ans. From the blind end of caecum, there arises a non functional finger like projection called appendix. Inflammation of appendix due to infection causes severe pain called appendicitis.

Q.4. What is Assimilation?

Ans. Conversion and incorporation of absorbed simple food into the complex substances constituting the body is called assimilation.

Q.5. What is a balanced diet? **(Lahore board 2011 G I)**

Ans. A balanced diet may be defined as the one which contains the essential nutrients like carbohydrates, fats, proteins, minerals, vitamins in the correct proportion for the normal growth and development of the body.

Q.6. What is bolus?

Ans. After the processes of chewing, lubrication and partial digestion, the pieces of bread and mutton are rolled up by tongue into small, slippery, spherical mass called bolus.

Q.7. What is cardiac sphincter?

Ans. Stomach has two sphincters (openings which are guarded by muscles).The cardiac sphincter is between stomach and oesophagus. The bolus enters the stomach through it.

Q.8. What do you know about chyme?

Ans. In stomach, partially digested food is converted to a soup like mixture called chyme.

Q.9. What do you know about colon?

Ans. Large intestine has 3 parts, caecum, colon and rectum. Colon is the second part of it, from colon water is absorbed in to the blood.

Q.10. What is constipation?

Ans. Constipation: is a condition of hardening of the faeces due to excessive absorption of water through colon.

Q.11. What is Diarrhoea?

Ans. Diarrhoea: Diarrhoea is a condition when required water is not absorbed in the blood from the colon. A sufferer has frequent watery, loose bowel movements. This condition accompanied by abdominal pain, nausea and vomiting.

Q.12. What are dietary fibres? **(Lahore board 2011 G II)**

Ans. Dietary fiber (also known as roughage) is the part of the human food that is indigestible. It is found in plant foods and it moves undigested through the stomach and small intestine and into the colon. It is of two types: a-soluble dietary fibre b-insoluble dietary fibre.

Q.13. Define Digestion?

Ans. The conversion of large and non diffusible molecules of food into smaller and diffusible molecules, by the action of enzymes is called digestion. It is of two types: a-chemical digestion b-mechanical digestion.

Q.14. What do you know about duodenum?

Ans. Duodenum comprises of the 10 inches (25 cm) of small intestine and it is the part of the alimentary canal where most of the digestive process occurs.

Q.15. What is emulsification?

Ans. Bile, a secretion of liver has bile salts, which keeps lipid droplets separate from one another this process is called emulsification.

Q.16. Define epiglottis and glottis?

Ans. Glottis: It is the opening of the wind pipe or trachea and the **Epiglottis** is a flap of cartilage over the glottis, which close the glottis during swallowing of food through food pipe.

Q.17. What is Famine?

Ans. Famine is the lack of enough food to feed all the people living in an area. Famine may be due to unequal distribution of food, drought, flooding or increase in population.

Q.18. What are Fat – soluble vitamins?

Ans. The vitamins which are soluble in fats and are much less excreted from body are called fat soluble vitamins. e.g. Vitamins A, D, E and K are called fat – soluble vitamins.

Q.19. What are fertilizers?

Ans. During cultivation, humans have added certain materials to the soil, resulted in plants with desireable characteristics (e.g. more fruit, faster growth, better colour and more attractive flowers). Such materials are named as fertilizers. Fertilizers are classified as:

(i) Organic Fertilizers (ii) In organic fertilizers

Q.20. Write composition of gartric juice. Where it is selected?

Ans. When food enters stomach, the gastric glands found in the stomach wall are stimulated to secrete gastric juice. It is composed chiefly of mucous, HCl and a protein digesting enzyme pepsinogen.

Q.21. What is gastrin?

Ans. Gastrin:- When protein in stomach is digested into peptides, these peptides stimulate the some cells of stomach wall to secrete a hormone gastrin into the blood and distributed to all parts of the body including stomach. Here it has specific effects and stimulates the cells of gastric glands to secrete more gastric juice.

Q.22. What is Goiter?

Ans. Iodine deficiency in diet causes enlargement of the thyroid gland. Due to enlargement, it becomes prominent and protrudes from neck region. This disease is called goiter.

Q.23. What is ileum?

Ans. Ileum: Last 3.5 m long part of small intestine is the ileum. It is concerned with the absorption of digested food from finger like structures called villi.

Q.24. Define inorganic fertilizers.

Ans. Inorganic fertilizers: Naturally occurring inorganic fertilizers are not chemically modified includes rock phosphate, elemental sulphur and gypsum. Most inorganic fertilizers dissolve in water so they efficiently supply the required nutrient for plant growth.

Q.25. What do you know about Intestinal juice?

Ans. Intestinal juice from the intestine walls contains many enzymes for the complete digestion of all kinds of food.

Q.26. What is Jejunum?

Ans. Next to duodenum is 2.4 meters long is jejunum. It is concerned with rest of digestion of Proteins, starch and lipids.

Q.27. What is kwashiorkor? **(Lahore board 2011 G II)**

Ans. Kwashiorkor: It is disease caused by protein deficiency at the age of about 12 months when breast feeding is discontinued. It can also develop at any time during a child's growing years. Children may grow to normal height but are abnormally thin.

Q.28. What is lacteal?

Ans. **Lacteal:** A vessel of lymphatic system which is present in Ileum is called lacteal. Fatty acids and glycerol are absorbed in it. It opens in main lymphatic duct from where they enter in bloodstream.

Q.29. What is Lipase?

Ans. Lipase is an enzyme in pancreatic juice secreted by pancreas helps in the digestion of Lipids.

Q.30. What do you know about liver? Give its two functions.

Ans. A dark reddish organ, the liver is the largest gland of the body. It lies beneath the diaphragm on the right side of the abdomen. It consists of a larger right lobe and smaller left lobe. A pear shaped greenish yellow sac the gall bladder is present on its right lobe.

Functions:

(i) Deamination: Removal of amino groups from Amino acids.

(ii) Detoxification: Conversion of Ammonia into Urea.

Q.31. What is malnutrition? How you can compare it from starvation?

Ans. Malnutrition is a term for the condition caused by an improper or insufficient diet. Malnourished people either do not take enough calories in their diet or are eating a diet that lacks proteins, vitamins or minerals.

Effects of malnutrition: It weakens the immune system, impairs physical and mental health, slow thinking, and stunt growth, hinders foetal development and leads to infectious diseases.

Q.32. What is marasmus? **(Lahore board 2012 G I)**

Ans. In humans, protein energy malnutrition (PEM) leads to an in adequate availability of energy and protein in body which leads to diseases such as marasmus: Usually develops between the age of six months and one year in children. Patients lose all their body fat and muscle strength and acquire a skeletal appearance. Children with marasmus show poor growth and look small for their age.

Q.33. What is mineral deficiency?

Ans. Nutrient deficiency cause mineral deficiency means less availability of required minerals. The most common result of mineral deficiency is the poor growth and development in children.

Q.34. What do you know about nutrition?

Ans. The process in which food is obtained or prepared, absorbed and converted into body substances for growth and energy is called nutrition.

Q.35. What is Oesophagus?

Ans. A tube behind the pharynx is called oesophagus which connects the pharynx to the stomach. It does not contribute to digestion of food when passing through it.

Q.36. What is oral cavity?

Ans. Oral cavity is the space behind mouth, and has many important functions. Food selection is one of them. Mastication, lubrication and chemical digestion of food are other functions.

Q.37. Define organic fertilizers.

Ans. **Organic fertilizers:** Derived from either plants or animals' materials. Organic fertilizers are more complex chemical substances that take time to be broken down into forms usable by plants. They have fewer salts so their larger amounts can be applied without injury to plant roots.

Q.38. What do you know about over intake of Nutritients?

Ans. Over intake of nutrients (OIN) is a form of malnutrition in which more nutrients are taken than the amounts required for normal growth, developments and metabolism.

Effects of over intake of nutrients are usually intensified when there is reduction in daily physical activity.

Q.39. What is Pancreas? What is its composition?

Ans. Pancreas is a leaf like organ lying below the stomach and between the two arms of the duodenum. It produces a juice called pancreatic juice.

Q.40. What is pancreatic juice?

Ans. It contains enzymes trypsin, lipase and pancreatic amylase, which digest protein, lipids and carbohydrates respectively. It is secreted by pancreas.

Q.41. What is pepsin?

Ans. **Pepsin:** Pepsin is an enzyme present in gastric juice, which partially digests the protein portion of the food (bulk of mutton) into polypeptide and shorter peptide chains.

Q.42. What is Pepsinogen?

Ans. A protein digesting enzyme is called pepsinogen. It is secreted by gastric glands of stomach. It is converted into Pepsin by HCl.

Q.43. What is Peristalsis?

Ans. A rhythmic contraction of alimentary canal to push food down i.e. from mouth to stomach is called Peristalsis. If due to any reason direction of peristalsis reverses, vomiting may occur.

Q.44. Where is Pharynx located?

Ans. The Pharynx is muscular passage way which extends from behind the nasal cavities to the opening of oesophagus and larynx.

Q.45. What is Protein-energy malnutrition? **(Lahore board 2011 G I)**

Ans. Protein-energy malnutrition refers to inadequate availability or absorption of energy and protein in the body. PEM may leads to diseases such as; kwashiorkor and marasmus.

Q.46. What is Pyloric sphincter?

Ans. The opening which is guarded by muscles is pyloric sphincter and is present between stomach and small intestine.

Q.47. What is rectum? Give its functions.

Ans. The last part of large intestine is called rectum.

Function: Faeces are temporarily stored in it which opens out through anus.

Q.48. What is Saliva? Give its function?

Ans. The three pairs of salivary glands (under the tongue behind the jaws and in front of ears) release a juice called saliva in oral cavity. Saliva has two functions.

(i) Its adds water and mucous to the food which acts as lubricant.

(ii) It has an enzyme amylase, which aids in the partial digestion of starch.

Q.49. What is Starvation?

Ans. It is a severe reduction in nutrient and energy intake and is the most horrible effect of malnutrition.

Q.50. What is stomach?

Ans. The stomach is a dilated part of the alimentary canal. It is J. shaped, located in the left of the abdomen just beneath the diaphragm. It is has two portions, the cardiac and the pyloric portion. Its walls have gastric glands which secretes gastric juice, which has HCl and pepsinogen, a protein digesting enzyme. In the stomach food is broken down and mixed with gastric juice by churning of it.

Q.51. What are trace minerals?

Ans. The minerals which are required by body in very small quantity less than 100 mg / day for functioning are called trace minerals i.e. Iron, Zinc, copper, chromium, flourine and Iodine are trace minerals.

Q.52. What are villi?

Ans. **Villi:** In the folds of ileum, finger like structures are present, these projections are richly supplied with blood capillaries and helps in absorption of digested food. They also increase the surface area of inner walls of small intestine.

Q.53. What are laxatives?

Ans. The medicines called laxatives (e.g. paraffin) are used for the treatment of constipation.

Q.54. What is swallowing?

Ans. Pushing of bolus to the back of mouth by tongue is called swallowing.

Q.55. What is Trypsin?

Ans. Pancreas secretes pancreatic juice in which an enzyme trypsin is present which helps in the digestion of proteins.

Q.56. What are Vitamins?

Ans. Vitamins are the chemical compounds that are required in low amounts but are essential for normal growth and metabolism. These are of two types

1- water soluble vitamins 2- Fat soluble vitamins

Q.57. What are water-soluble vitamins?

Ans. Vitamins B and C are known as water- soluble vitamins. These are soluble in water, so are excrearted from the body as compared to fat soluble vitamins which are much less excreted. So levels of water soluble vitamins in the body can decrease quickly leading to vitamin deficiency.

Q.58. Why meat is not a good source of vitamin C.? **(Lahore board 2011 G II)**

Ans. Minute quantities of vitamin C are present in muscles. Since meat consists of muscles so it is not a good source of vitamin C.

Unit 09

TRANSPORT

Q.1. Why transport is necessary? How it takes place in living organisms?

Ans. Why transport is necessary:

In order to run the metabolic processes occurring in the body of living organisms, cells need some materials from environment and also cells need to dispose some material into the environment. For this purpose, materials are transported to and from cells.

Transport in living organisms:

In unicellular and simple multicellular organisms, diffusion can work only because every corner of their body is in close and direct contact with environment. In complex multicellular bodies, cells are far apart from the environment and such bodies need a comprehensive system for transport of materials.

Q.2. Describe briefly transport in plants?

Ans. Role of water:

Water plays a vital role in life of plants, because it is necessary for.

(i) Photosynthesis

(ii) Turgor

(iii)Regulation of temperature within cell.

Absorption of water:

Land plants get water and minerals from soil through roots, and transport it to the aerial parts of plants. During photosynthesis, food is prepared and transported from leaves to other parts of plants for utilization and storage.

Transport of water and Food:

Vascular tissues (xylem and Phloem) are present in all plants, (except for mosses and liverworts), that move water and food throughout the plant body.

Figure 9.1: Uptake of water and ions by root

Q.3. Describe how water and ion uptake occurs in plants?

Ans. Introduction:

In addition to anchoring the plant, roots perform two other vital functions.

(i) Absorbs water and salts from the soil.

(ii) Secondly, they provide conducting tissues for distributing these substances to the tissues of the stem.

2. Internal Structure of Root

(i) Conducting Tissues

Conducting tissues (xylem and phloem) of root are grouped in the centre to form a rod shaped core, which extends throughout the length of the root.

(ii) Pericycle

Outside the conducting tissues, there is a narrow layer of thin walled cells, the pericycle.

(iii)Endodermis and Cortex

A single layer of cells, endodermis surrounds the pericycle layer. External to this, there is a broad zone of cortex which consists of large and thin walled cells.

(iv) Epidermis

The cortex is bounded on the outside by a single layer of epidermal cells.

(v) Root Hairs

Roots also have cluster of tiny root hairs, which are actually the extensions of epidermal cells.

Functions of Root Hair:

(i) Large Surface Area for Absorption

Root hairs provide large surface area for absorption. They grow out into the spaces between soil particles where they are in direct contact with the water.

(ii) Absorption and Transport of Water

The cytoplasm of the root hairs has higher concentration of salts than the soil water, so water moves by osmosis into the root hairs. Salts also enter root hairs by diffusion or active transport. After their entry into the root hairs, water and salts travel through intercellular spaces or through cells (via channels, called plasmodesmata) and reach xylem tissues. Once in xylem, water and salts are carried to all the aerial parts of plant.

Q.4. What is transpiration. Describe transpiration and factors affecting rate of transpiration.

Ans. Transpiration:

1. Definition:

"The loss of water from plant surface through evaporation is called transpiration".

2. Occurrence of transpiration:

This loss may occur through stomata in leaves, through the cuticle present on leaf

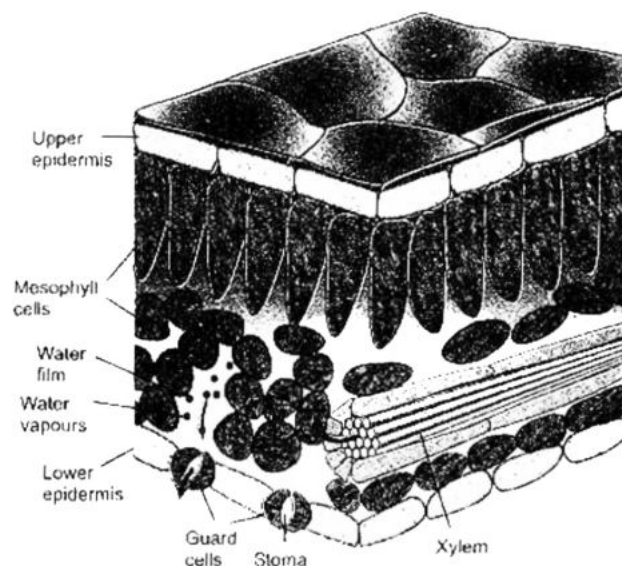



Figure 9.2: Events of transpiration shown in the section of a leaf

epidermis, or through special openings called lenticels present in the stems of some plants.

3. Stomatal transpiration:

Most of the transpiration occurs through stomata and is called stomatal transpiration. The mesophyll cells of leaf provide large surface area for the evaporation of water. Water is drawn from the xylem into mesophyll cells. from where it comes out and makes a water-film on the cell walls of the mesophyll. From here, water evaporates into the air spaces of the leaf. By diffusion, water vapours then move from air spaces towards the stomata and then pass to outside air. Roughly 90% of the water that enters a plant is lost via transpiration.

4. Opening and closing of stomata:

(i) Process of opening and closing of stomata

Most plants keep their stomata open during the day and close them at night. The two guard cells of a stoma are attached to each other at their ends. The inner concave sides of guard cells that encloses a stoma are thicker than the outer convex sides. When these guard cells get water and become turgid, their shapes are like two beans and the stoma between them opens . When the guard cells loose water and become flaccid, their inner sides touch each other and the stoma closes.

(ii) Mechanism of stomatal opening and closing

(a) Concentration of solute (Glucose) in the guard cell is responsible for opening and closing of stomata. Recent studies have revealed that light causes the movement of (K^+) Potassium ions from epidermal cells into guard cells.

(b) Water follows these ions and enter guard cells. Thus their turgidity increases and stoma opens.

(c) As the day progresses, guard cells make glucose i.e., become hypertonic. So water stays in them. At the end of the day, the K^+ flow back from guard cells to the epidermal cells and the concentration of glucose also falls. This initiates the loss of water and reduces turgor pressure in guard cells, which causes the closure of stomata.

Factors affecting rate of transpiration **(Lahore board 2011 G I,II)**

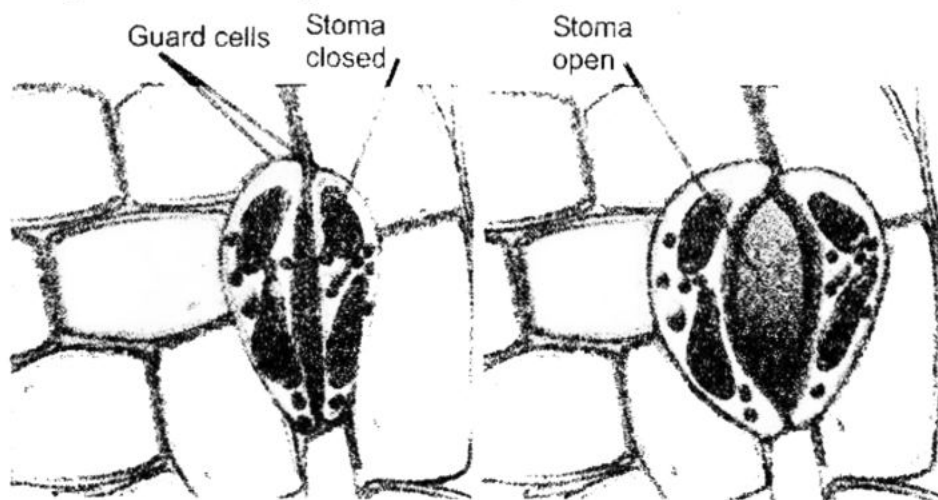



Figure 9.3: Opening and closing of stoma

Following factors affect the rate of transpiration.

1. Light

The rate of transpiration is directly controlled by opening and closing of stomata and it is under the influence of light. In strong light, the rate of transpiration is very high as compared to dim light or no light.

2. Temperature

Higher temperature reduces the humidity of the surrounding air and also increases the kinetic energy of water molecules. In this way, it increases the rate of transpiration. The rate of transpiration doubles with every rise of 10° C in temperature. But very high temperature i.e., 40-45° C causes closure of stomata, so that transpiration stops.

3. Air Humidity **(Lahore board 2012 G II)**

When air is dry, water vapours diffuse more quickly from the surface of mesophyll cells into leaf air spaces and then from air spaces to outside. This increases the rate of transpiration. In humid air, the rate of the diffusion of water vapours is reduced and the rate of transpiration is low.

4. Air movement

Wind (air in motion) carries away the evaporated water from leaves and it causes an increase in the rate of evaporation from the surfaces of mesophyll. When air is still, the rate of transpiration is reduced.

5. Leaf Surface area

The rate of transpiration also depends upon the surface area of leaf. More surface area provides more stomata and there is more transpiration.

Q.5. Describe the significance of transpiration?

(Lahore board 2011 GII)

Ans. Introduction

Transpiration is called a necessary evil. It means that transpiration is a potentially harmful process but is unavoidable too.

1. How transpiration is harmful?

Transpiration may be a harmful process in the sense that during the conditions of drought, loss of water from the plant results in serious desiccation, wilting and often death of the plant.

How is transpiration necessary?

(Lahore board 2012 G I)

(i) Transpirational Pull

It creates a pulling force called transpirational pull which is principally responsible for the

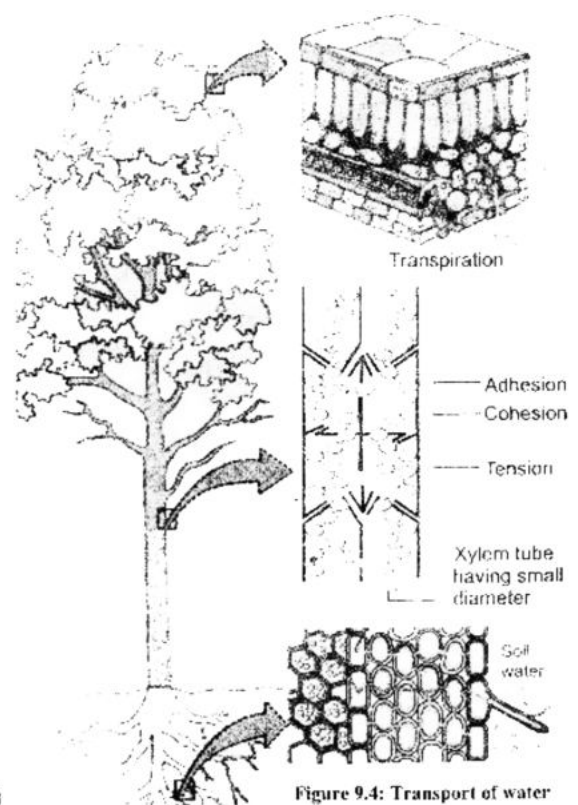



Figure 9.4: Transport of water

conduction of water and salts from roots to the aerial parts of the plant body.

(ii) Cooling effect

When water transpires from the surfaces of the plant, it leaves a cooling effect on plant. This is especially important in warmer environments.

(iii)Gaseous exchange

Wet surfaces of leaf cells allow gaseous exchange.

Q.6. How transport of water in plants takes place?

Ans. Introduction:

The process by which water is raised to considerable heights in plants can be explained by cohesion tension theory.

Cohesion-tension theory

According to this theory, the force which carries water (and dissolved materials) upward through the xylem is transpirational pull. Transpiration creates a pressure difference that pulls water and salts up from the roots.

Explanation

When a leaf transpires (loses water), the water concentration of its mesophyll cells drops. This drop causes water to move by osmosis from the xylem cells of leaf into the mesophyll cells. When one water molecule moves up in the xylem of the leaf, it creates a pulling force that continues all the way to the root. This pulling force created by the transpiration of water is called transpirational pull. It also causes water to move transversely (from root epidermis to cortex and pericycle).

Reasons for the creation of the transpiration pull

(i) Water is held in a tube (xylem) that has small diameter.

(ii) Water molecules adhere to the walls of xylem tube (adhesion).

(iii) Water molecules cohere to each other (cohesion).

These attractions allow an overall tension among water molecules and form 'columns' of water. The columns of water move from root to shoot and the water content of the soil enters in these columns.

Q.7. How transport of food in plants takes place?

Ans. Transport of Food

Phloem is responsible for transporting food substance throughout the plant. Phloem is a two way street for food. In most plants, the food is transported in the form of sucrose.

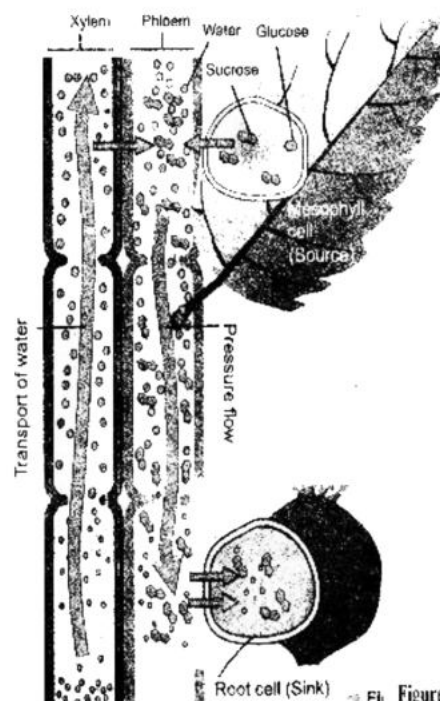



Figure 9.5: Transport of food

Importance of Food

The glucose formed during photosynthesis in mesophyll cells is used in respiration and excess of it is converted into sucrose.

Pressure-Flow mechanism

In pressure-flow mechanism, the food is moved from sources to sinks.

Sources:

The sources include the exporting organs typically a mature leaf or storage organ. A storage organ is capable of storing food and exporting the stored materials.

Sinks:

Sinks are the areas of active metabolism or storage e.g., roots, tubers, developing fruits and leaves, and the growing regions. Similarly, root of beet is a sink in first growing season, but becomes source in the next growing season, when sugars are utilized in the growth of new shoots.

Explanation of Pressure-Flow mechanism

At the source, the food (sugar) is moved by active transport into the sieve tubes of phloem.

Due to the presence of sugar in sieve tubes, their solute concentration increases and water enters from xylem via osmosis. This results in higher pressure in these tubes, which drives the solution towards sink.

At the sink end, the food is unloaded by active transport. Water also exits from the sieve tubes. This decreases the pressure in sieve tubes, which causes a mass flow from the higher pressure at the source to the now lowered pressure at the sink.

Q.8. Explain the mechanism of transportation in human.

Ans. Transport in Human:

Transportation in human body consists of two complex systems.

(i) Blood circulatory system (cardio vascular system)

(ii) Lymphatic system

Closed Circulatory System

Human body have closed circulatory system (mean blood never leaves the network of arteries, veins and capillaries)

Main components of human blood circulatory system:

(i) Blood (Medium)

(ii) The heart (Pumping organ)

(iii) Blood vessels

Q.9. Write a note on composition of blood?

Ans. Blood:

Introduction

It is a specialized bodily fluid made up of connective tissue. It is composed of a liquid called blood plasma and blood cells.

Weight

Weight of blood in our body is about 1/12th of our body.

Average Blood Volume in Adult

Average adult body has about 5 litres of blood.

Composition of Blood

In healthy person, plasma constitutes about 55% and cell or cell like bodies about 45% by volume of the blood.

Figure 9.6: Percentage composition of human blood

Chemical Composition of Blood Plasma **(Lahore board 2012 G II)**

Water constitutes about 90-92% of Plasma and 8-10% are dissolved substances. Following materials present in the water of Plasma.

(i) Salts:

Salts make up 0.90% of the plasma by weight, Sodium chloride and Salts of bicarbonate are present in considerable amount. Ca, Mg. Cu, K and Zn are found in trace amounts. Changes in concentration of any salt can change the pH of blood. (Normal is 7.4)

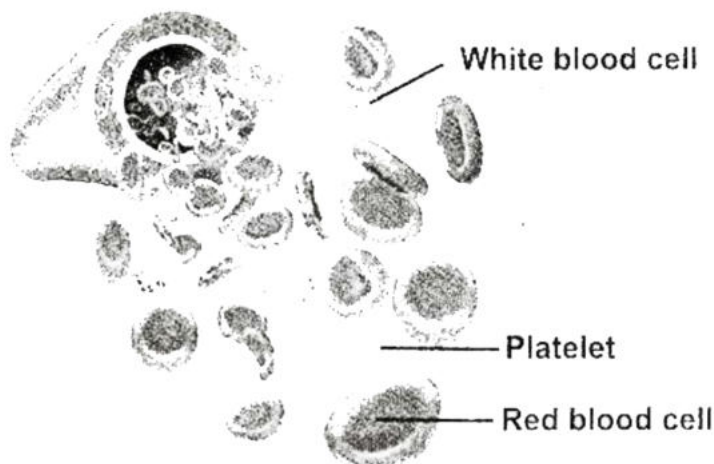



Figure 9.7: Different cells and Cell-like bodies in blood plasma

(ii) Proteins

Proteins make 7-9% by weight of plasma. The important proteins present in plasma are antibodies, fibrinogen (blood clotting protein), albumin (maintains the water balance of blood) etc.

(iii) Digested Food, Nitrogenous Wastes and Hormones

Plasma also contains the digested food (absorbed from digestive system), nitrogenous wastes and hormones.

(iv) Respiratory Gases

Respiratory gases i.e., CO_2 and O_2 are also present in plasma.

TYPES OF BLOOD CELLS IN PLASMA

1. Erythrocytes or red blood cells. (RBCs)

Number:

A cubic millimeter of blood contains 5 to 5.5 million red blood cells in males and 4 to 4.5 million in females.

Loss of Nucleus and other organelles

In the RBC's of mammals, the nucleus is lost when they get mature.

Composition of Cytoplasm of RBCs

95% of the cytoplasm of RBCs is filled with haemoglobin which transports O_2 and CO_2. The remaining 5% consists of enzymes, salts and other Proteins.

Shape

RBCs are biconcave and have an elastic cell membrane.

Formation

In the embryonic and foetal life, they are formed in liver and spleen.

In adults, they are formed in the red bone marrow of short and flat bones, such as the sternum, ribs and vertebrae.

Average Life Span

The average life span of a red blood cell is about four months (120 days) after which it breaks down in liver and spleen by phagocytosis.

Production and Death

In a normal person, about 2-10 million red blood cells are formed and destroyed every second.

2. White Blood Cells or Leukocytes (WBCs)

Introduction

These are colourless.

Location

They are not confined to blood vessels only as they also migrate out into the tissue fluid.

Number

One cubic millimeter of blood contains 7000 to 8000 WBCs.

Life Span

Their life span ranges from months to even years, depending on body's need.

Function

WBCs function as the main agents in body's defence system.

Types of leukocytes:

Leukocytes are divided into two main types.

(i) Granulocytes

(ii) Agranulocytes

(i) Granulocytes

Granulocytes are the leukocytes with granular cytoplasm. These include neutrophils, eosinophils and basophils.

(i) Neutrophils:

They destroy small particles by phagocytosis.

(ii) Eosinophils:

They break inflammatory substances and kill parasites.

(iii)Basophils:

They prevent blood clotting.

(ii) Agranulocytes

Agranulocytes are the leukocytes with clear cytoplasm. These include monocytes and lymphocytes (B & T lymphocytes).

(i) Monocytes

They produce macrophages which engulf germs.

(ii) Lymphocytes

They produce antibodies and kill germs.

3. Platelets (Thrombocytes)

Introduction

They are not cells, but are fragments of large cells of bone marrow called megakaryocytes. They do not have any nucleus and any pigment.

Number

One cubic millimeter of blood contains 250,000 platelets.

Life Span

The average life span of a blood platelet is about 7 to 8 days.

Function:

They play an important role in blood clotting. The clot serves as a temporary seal at the damaged area.

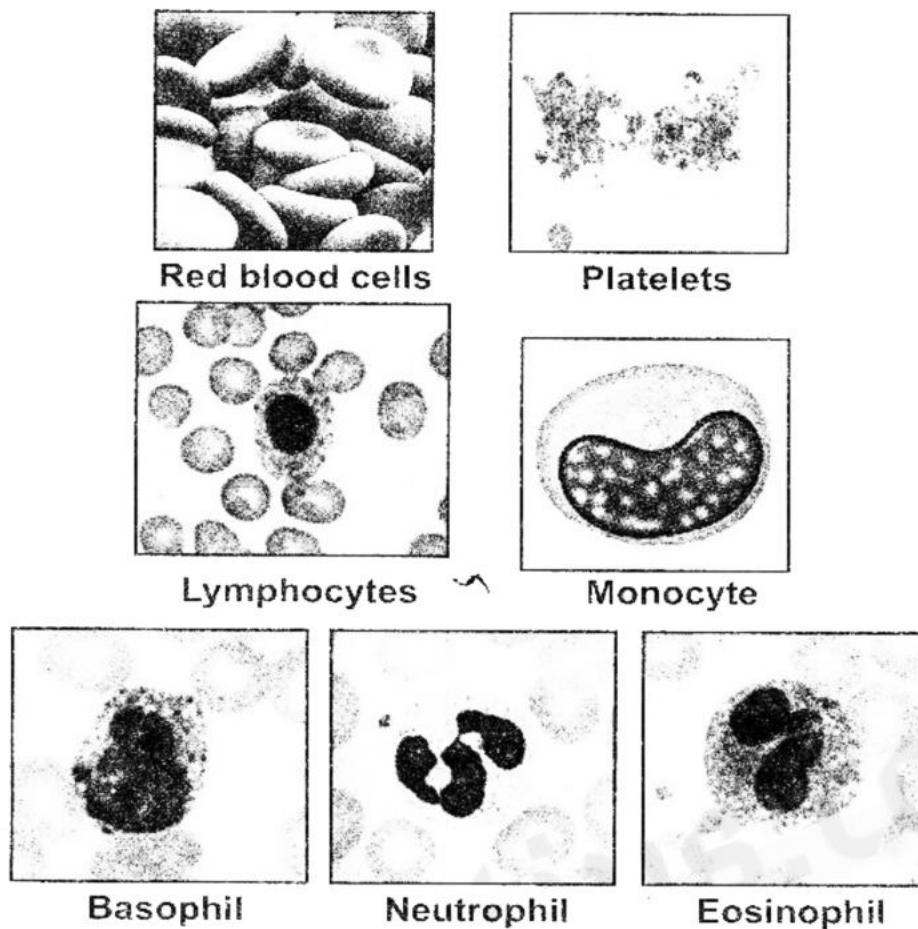



Figure 9.8: Composition of Blood

Table 9.1: Composition of Blood

	Description	**Amount in %age**	**Functions**
Plasma	Liquid portion of blood	55% by volume	Carries blood cells and important blood proteins, hormones, salts etc.
Cell Types	**Description**	**Average Number Present**	**Functions**
Red Blood Cells (Erythrocytes)	Like a biconcave disc; without nucleus; Contain haemoglobin	5,000,000 per mm^3	Transport Oxygen and a small amount of CO_2
White Blood Cells (Leukocytes)	Granular and agranular; contain nucleus larger in size than RBCs	7500 per mm^3	Play role in body's defense by different ways like: Engulf small particles, Release

			anticoagulants, Produce antibodies
Platelets (Thrombocytes)	Fragements of bone marrow cells (megakaryoctes)	250,000 per mm^3	Involved in blood clotting

Q.10. Explain different disorders of blood.

Ans. Blood Disorder:

There are many types of blood disorders including.

(i) Bleeding disorders. (Haemophilia)

(ii) Leukaemia (blood cancer)

(iii) Thalassaemia (Cooley's Anaemia)

i. Leukaemia (Blood Cancer)

Leukaemia is the production of great number of immature and abnormal white blood cells.

Cause of leukaemia:

It is caused by a cancerous mutation in bone marrow or lymph tissue cells and result in uncontrolled production of WBCs.

Treatment:

(i) During this serious disorder, patients need to change the blood regularly with the normal blood, got from donar.

(ii) The second method is bone marrow transplant, which is in most cases effective, but very expensive treatment.

ii. Thalassaemia (Cooley's anaemia)

It is also called Cooley's anaemia on the name of Thomas B. Cooley, an American Physician. It is a genetic problem due to mutation in the gene of haemoglobin. Patient cannot transport oxygen properly.

Cause of Thalassaemia:

The mutation results in the production of defective haemoglobin.

Treatment:

(i) Blood of patients is to be replaced regularly with normal blood.

(ii) It can be cured by bone marrow transplantation but it does not give 100% cure rate.

Q.11. Describe in detail blood group systems.

Ans. Blood group systems:

Blood group systems are a classification of blood, based on presence or absence of antigens on the surface of RBCs.

Antigen:

An antigen is a molecule that can stimulate an immune response (antibody production etc).

ABO Blood Group System:

(i) Discovery

It was discovered by the Austrian scientist Karl Land Steiner, in 1900.

(ii) Four Different Blood Groups

In this system, there are four different blood groups which are distinct from each other on the basis of specific antigens (Antigen A and B) present on the surface of RBCs.

Blood group A:

A person having antigen A has blood group A.

Blood Group B:

A person with antigen B has blood group B.

Blood Group AB

A person having both antigens has blood group AB.

Blood Group O:

A person having none of the A and B antigens has blood group O.

	Blood group A	Blood group B	Blood group AB	Blood group O
Red blood cell				
Antigen present	antigen A	antigen B	Antigen A & B	None
Antibody present	Anti-B	Anti-A	None	Anti-A & Anti-B

Figure 9.9: Presence and absence of antigens and antibodies in ABO blood group system

Types of Antibodies

After birth, two types of antibodies i.e. anti-A and anti-B antibodies appear in the blood of individuals.

(i) In persons with blood group A, antigen A is present and antigen B is absent. So their blood will contain Anti B anti bodies.

(ii) In person with blood group B, antigen B is present and antigen A is absent. So their blood will contain anti A antibodies.

(iii) In persons with blood group AB, antigen A & B are present i.e. neither is absent. So their blood serum will contain no antibody.

(iv) In persons with blood group O, neither antigen A nor antigen B is present i.e. both are absent so their blood serum will contain both anti A and anti B antibodies.

Q.12. Describe blood transfusion in ABO blood group system.

Ans. Definition:

A process of transferring blood or blood based product from one person into the circulatory system of another is called blood transfusion.

Need of Blood Transfusion:

It is a life saving process in some situation, such as massive blood loss due to injury. It can be used to replace blood lost during surgery, anaemia, sickle cell anaemia, thalassaemia, or Haemophilia may require frequent blood transfusions.

Cross Matching of Blood Groups:

Transfusion of blood is done after confirming that no agglutination results in the blood of recipient. Agglutination leads to the clumping of cells and clumped cells can not pass through capillaries. For the confirmation of no agglutination, blood samples of donor and recipient are crossed-matched for compatibility. Antibodies of the recipient's blood may destroy the corresponding antigen containing RBCs of the donor or the antibodies of the donor's blood may destroy the antigen-containing RBCs of the recipient.

Universal donor:

O blood group individuals are called universal donors, because they can donate blood to the recipients of every other blood group.

Universal Recipients

AB blood group individuals are called universal recipients, because they can receive transfusions from the donors of every other blood group.

Recipient Blood Groups

Donor Blood Groups	A	B	AB	O
A	✓	×	✓	×
B	×	✓	✓	×
AB	×	×	✓	×
O	✓	✓	✓	✓

Blood Transfusion: Cross matching

✓ : **can be transfused**

× : **agglutination**

Q. 13. What do you mean by Rh Blood group system? Explain Blood transfusion in Rh Blood group system?

Ans. Discovery of Rh-blood Group System:

In 1930's, Karl Land Steiner discovered the Rh-blood group system.

Rh System:

In this system, there are two blood groups, i.e., Rh^+ positive and Rh^- negative.

Rh Factor:

These blood groups are distinct on the basis of antigens called Rh factor (first discovered in Rhesus Monkey) present on the surface of RBCs.

Rh Positive and Rh Negative:

A person having Rh factors has blood group Rh positive while a person not having Rh factors has blood group Rh negative.

Blood transfusion in Rh Blood Group System:

Rh-positive blood group can be transfused to Rh-positive recipient because recipient's blood already has Rh-antigens and it will not produce anti-Rh antibody. Rh-negative blood

group can be transfused to Rh-negative because donor's blood does not have Rh-antigen and so recipient's blood will not produce anti-Rh antibody. If an Rh-negative person receives Rh positive blood,

(i) He/she will produce anti Rh antibodies against Rh factors.

(ii) Rh negative blood can be transfused to Rh positive recipient, only if donor's blood (Rh negative) has never been exposed to Rh antigens and does not contain any anti Rh antibody.

Q.14. Describe the structure and function of human heart?

Ans. Introduction

The heart is a muscular organ responsible for pumping blood through the blood vessels by repeated contractions.

Meaning of Cardiac

The term cardiac means "related to the heart". Walls of heart chambers are made of cardiac muscles.

Location

In the human body, the heart is situated between the lungs, in the middle of the chest cavity (thorax) under the breast bone.

Pericardium and Pericardial Fluid

The heart is enclosed in a sac known as the Pericardium. There is a fluid, known as pericardial fluid between the Pericardium and the heart walls.

Function of Pericardial fluids:

It reduces friction between the pericardium and the heart, during heart contractions.

Chambers of Human Heart

The human heart consists of four chambers.

(i) Right and Left Atria

The upper thin walled chambers are called the left and right atria.

(ii) Right and Left Ventricles

The lower thick walled chambers are called the left and right ventricles. The left ventricle is the largest and strongest chamber in heart.

Working of Heart as a Double Pump

It works as a double pump. It receives deoxygenated (with less oxygen) blood from body and pumps it to lungs. At the same time, it receives oxygenated (with more oxygen) blood from lungs and pumps it to the whole body.

Figure 9.10: Human heart; structure and

Circulation of Blood (Double Pump Mechanism)

(i) Circulation of Deoxygenated Blood

Right atrium receives deoxygenated blood from the body via the main veins i.e. superior and inferior vena

cava. When right atrium contracts, it passes the deoxygenated blood to the right ventricle. When right ventricle contracts, the blood is passed to pulmonary trunk which carries blood to the lungs.

(ii) Tricuspid Valve

The opening between the right atrium and the right ventricle is guarded by a valve (because it has 3 flaps). It prevents the backflow of blood from right ventricle to the right atrium.

(iii) Pulmonary Semilunar Valve

Location:

At the base of the pulmonary trunk, pulmonary semilunar valve is present.

Function:

It prevents the backflow of blood from pulmonary trunk to right ventricle.

(iv) Circulation of Oxygenated Blood:

The oxygenated blood from the lungs is brought by pulmonary veins to left atrium. The left atrium contracts and pumps this blood to the left ventricle. When the left ventricle contracts, it pumps the oxygenated blood in aorta, which carries the blood to all parts of the body (except lungs).

Figure 9.11 Double circuit circulation of blood

(v) Bicuspid Valve

The opening between the left atrium and the left ventricle is guarded by a valve known as bicuspid valve (because it has two flaps).

Function:

It prevents the back flow of blood from the left ventricle to the left atrium.

(vi) Aortic Semilunar Valve

Location:

At the base of aorta, the aortic semilunar valve is present.

Function:

It prevents the back flow of blood from aorta to the left ventricles.

Q. 15. Define pulmonary circulation and systemic circulation.

Pulmonary circulation or circuit

The pathway on which deoxygenated blood is carried from the heart to the lungs and in return oxygenated blood is carried from the lungs to the heart is called pulmonary circulation or circuit.

Systemic circulation or Circuit

The pathway on which oxygenated blood is carried from the heart to the body tissues and in return deoxygenated blood is carried from the body tissues to the heart is called systemic circulation or circuit.

Q. 16. Describe cardiac cycle and Heartbeat.

Cardiac cycle and Heartbeat

The alternating relaxations and contractions of chambers of heart make up the cardiac cycle and one complete cardiac cycle makes one heart beat.

Steps of Cardiac Cycle

(i) Cardiac diastole

The atria and ventricles relax and blood is filled in atria. This period is called cardiac diastole.

(ii) Atrial Systole

Immediately after the filling of atria, both atria contract and pump the blood towards ventricles. This period in cardiac cycle is called atrial systole.

(iii) Ventricular Systole

When both ventricles contract and pump the blood towards body and lungs, the period of ventricular contraction is called ventricular systole.

Figure 9.12: One cardiac cycle

In one heartbeat, diastole lasts about 0.4 seconds, atrial systole takes about 0.1 seconds, and the ventricular systoles lasts about 0.3 seconds.

"Lubb Dubb"

When ventricles contract, the tricuspid and bicuspid valves close and "lubb" sound is produced. Similarly when ventricles relax, the semilunar valves close and "dub" sound is produced. "Lubb dubb" can be heared with the help of a stethoscope.

Heart rate:

The heart rate is the number of times the heart beats per minute.

Normal Range of Heart rate

At rest or during normal activities, the heart beats 70 times per minute in men and 75 times per minute in women.

Measurement of Heart Rate

The heart rate can be measured by feeling the pulse.

Pulse

Pulse is the rhythmic expansion and contraction of an artery as blood is forced through it by the regular contractions of the heart.

Measurement Areas of Pulse:

The pulse can be felt at the areas where the artery is close to the skin for example at wrist, neck, groin or the top of the foot.

Most commonly, people measure their pulse in their wrist.

Figure 9.13: Method of taking pulse

Q.17. Write a note on different types of blood vessels.

Ans. Blood vessels

Third most important part of blood circulatory system are blood vessels. Their function is to transport blood throughout body.

Types of Blood Vessels

1. Arteries

Definition

Arteries are the blood vessels, that carry blood away from the heart. All arteries with the exception of the pulmonary artery, carry oxygenated blood.

Structure

The structure of the arteries is adapted to their function. The walls of an artery are composed of three layers.

Outer most layer

The outer most layer is made of connective tissue.

Middle layer

Middle layer is made up of smooth muscles and elastic tissue.

Inner most layer

The inner most layer is made up of endothelial cells. The hollow internal cavity in which the blood flow is called the lumen.

Arterioles

When arteries enter body organ, they divide into smaller vessels known as arterioles. The arterioles enter tissues and further divide into capillaries.

2-Capillaries:

Definition:

Capillaries are the smallest blood vessels which are formed by the divisions of arterioles.

Structure:

The walls of capillaries are composed of only a single layer of cells, the endothelium. This layer is so thin that molecules of digested food, oxygen and water etc. can pass through them and enter the tissue fluid.

Process occurring in Capillaries:

The exchange of materials between blood and tissue fluid is carried through capillaries.

Waste products

Waste product such as carbon dioxide and urea can diffuse from tissue fluid into the blood.

3. Veins

Definition:

A Vein is the blood vessel that carry blood toward the heart. In adult, all veins with the exception of pulmonary vein, carry deoxygenated blood.

Structure:

Veins are also well adapted to their function. The walls of veins are composed of same three layers as are present in the artery wall with the difference that the middle layer of vein has less smooth muscles and elastic tissue as compared to artery. The lumen of the veins is broader than that of arteries.

In a tissue, capillaries join to form small venules, which join to form veins. Most veins have flaps, called valves that prevent the back flow of blood.

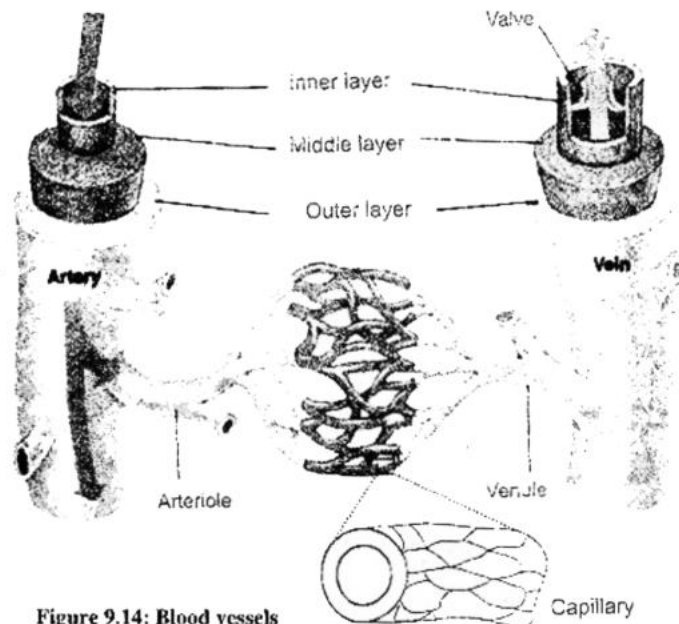



Figure 9.14: Blood vessels

Table 9.2: Comparison between arteries, veins and capillaries.

Characteristics	Arteries	Capillaries	Veins
Function	Carry blood away from heart	Allow the exchange of materials between blood and tissues	Carry blood towards heart
Thickness and Elasticity in walls	Thick and elastic	One-cell thick non-elastic walls	Thin and less elastic
Muscles in walls	Thick	No muscles	Thin
Blood pressure	High BP	Medium	Low BP
Valves	No valves	No valves	Valves present

Q.18. Explain general plan of human blood circulatory system. OR
Describe Human Arterial and Venous System in detail.

Ans. Many scientists worked on circulation of blood in human body. Following two important scientists gave the knowledge of the blood circulatory system:

(i) Ibn-e-Nafees (1210-1286): He was physician and the first scientist who described the pathway of blood circulation.

(ii) William Harvey (1578-1651): He discovered the pumping action of heart. He also described the pathway of blood in major arteries and veins.

Figure 9.15: Major arteries and veins in human body

The Arterial System

Pulmonary arteries

The large pulmonary trunk emerges from the right ventricle. It divides into right and left pulmonary arteries. These arteries carry the deoxygenated blood to the right and the left lungs.

Aorta and Dorsal Aorta

The oxygenated blood leaving the left ventricle of the heart is carried in a large artery i.e aorta. The aorta ascends and forms an aortic arch. The arch curves left and descends inferiorly into the body. Three arteries arises from the upper surface of the aortic

arch. These arteries supply blood to head, shoulders and arms. As aorta passes down through the thorax, it becomes the dorsal aorta. The dorsal aorta gives many branches. These are:-

(i) Intercostal arteries: Several intercostal arteries supply blood to the ribs.

(ii) Caeliac artery and superior mesenteric arteries: The caeliac artery and the superior mesenteric artery supplies blood to digestive tract.

(iii) Hepatic arteries: Hepatic artery supplies blood to the liver.

(iv) Renal arteries: A pair of renal arteries that supply blood to kidneys.

(v) Gonadal arteries: These arteries supply blood to the gonads.

(vi) Inferior mesenteric artery: It is present just below the gonadal arteries. It supplies blood to large intestine and rectum.

(vii) Common iliac Arteries: Then the aorta divides into two common iliac arteries, each of which divides into two arteries:

(i) Internal iliac artery: It supplies blood to legs.

(ii) External iliac artery: Each external iliac becomes the femoral artery in the upper thigh. It gives branches to thigh, knee, shank, ankle and foot.

Coronary circulation

Heart muscles also require blood. The blood supply to the heart muscles is provided by the coronary arteries. It arises from the base of the aorta. The coronary veins collect blood from the heart muscles. It empties into the right atrium. The coronary arteries and veins are collectively comprise coronary circulation. It is a part of the systemic circulation.

The Venous System

(i) Pulmonary veins: Veins from lungs called pulmonary veins return oxygenated blood to left atrium of the heart.

(ii) Two Major veins

Two major veins i.e. superior vena cava and inferior vena cava carry the deoxygenated blood from rest of the body and empty into right atrium.

(a) Superior vena cava: It is a major vein. Different veins from the head, shoulders and arms join together. They form superior vena cava. It opens into right atrium.

(b) Inferior vena cava: It is formed by many veins in the legs. It brings deoxygenated blood to the heart.

(i) Common iliac veins: Veins carrying blood from calf, foot and knee join together to form the femoral vein. Femoral veins opens into the external iliac vein which joins with the internal illiac to form common iliac vein. The right and left common iliac veins join to form the inferior vena cava.

(ii) Renal veins: The two renal veins carry blood from the kidneys.

(iii) Gonadal veins: Two gonadal veins carry blood from gonads to the inferior vena cava.

(iv) Hepatic portal system: Veins coming from the stomach, spleen, pancreas and intestine drain into the hepatic portal vein. It carries the blood to the liver. From liver, hepatic vein carries blood and empties into inferior vena cava.

(v) In the thoracic cavity, the inferior vena cava also receives veins from thoracic walls and ribs.

Q.19. Write a note on cardiovascular disorders.

Ans. Diseases that involve the heart or blood vessels are collectively called cardiovascular disorders.

Causes of cardiovascular Diseases:

i. Advanced age
ii. Diabetes
iii. High blood concentration of low density lipids, (e.g. cholesterol) and triglycerides,
iv. Tobacco smoking
v. High blood pressure (Hypertension)
vi. Obesity
vii. Sedentary life style

Atherosclerosis:

Definition:

Disease affecting arteries, commonly referred to as a narrowing of the arteries is called Atherosclerosis.

Causes:

It is a chronic disease in which there is accumulation of fatty material cholesterol or fibrin in arteries.

i. When this condition is severe, arteries can no longer expand and contract properly and blood moves through them with difficulty.
ii. Cholesterol is accumulated in the vessels which results in the formation of multiple deposits called plaques within arteries.
iii. Plaques can form blood clots called thrombus within arteries.
iv. If a thrombus dislodges and becomes free floating, it is called an embolus.

Arteriosclerosis:

Arteriosclerosis is a general term describing any hardening of arteries. It occurs when calcium is deposited in the walls of arteries, it can happen when atherosclerosis is severe.

Myocardial infarction

Definition:

It is commonly known as heart attack.

Causes:

i. It is a Medical condition that occurs when blood supply to a part of the heart is interrupted and leads to death of heart muscles.

ii. Blood clot in coronary arteries.

Tissue death

The term myocardial infarction is derived from myocardium (heart muscle) and infraction (tissue death)

Symptoms

(i) Severe chest pain is the most common symptom of heart attack.

(ii) It often describes as a sensation of tightness, pressure or squeezing.

(iii) Pain radiates, most often to left arm but may also radiate to lower jaw, neck, right arm and back.

(iv)Loss of consciousness and even sudden death can occur in myocardial infarction.

Treatment

(i) Immediate treatment for suspected acute myocardial infarction is oxygen supply

(ii) Aspirin and sublingual tablet of glycerol trinitrate.

(iii)In most cases, it is treated with angioplasty, (mechanical widening of a narrowed or totally obstructed blood vessel) or bypass surgery (surgery in which arteries or veins from elsewhere in the patient's body are grafted to the coronary arteries to improve the blood supply to heart muscles).

Angina Pectoris:

Angina Pectoris means "chest pain" occurs for reason similar of those which cause heart attack. But it is not as severe as heart attack. The pain may occur in heart and often in left arm and shoulder. It is a warning sign that the blood supply to the heart muscles is not sufficient but the shortage is not enough to cause tissue death.

Silent heart attack:

Approximately one fourth of all myocardial infarctions are silent, without any chest pain or other symptoms. A silent heart attack is more common in the elderly patients with diabetes mellitus and after heart transplantation.

World heart day:

World heart day held on 28^{th} September every year throughout the world. Its objective is to help people better understand their personal risk of cardiovascular disorders.

Fig: 9.16 Atherosclerosis and resulting Myocardial infarctior

Myocardial infarction in Pakistan:

i. Cardiovascular disorders are the cause of 12% of the adult death in Pakistan (source, federal Bureau of Statistics of Pakistan)

ii. Hypertension (high blood pressure) is most common cause of cardio vascular disorder in Pakistan.
iii. There are over 12 million hypertension patients in Pakistan.
iv. About 10% of our population is diabetic.
v. According to world health organization in Pakistan, one in 7 urban adults are obese.

Multiple Choice Questions

1. In most plants, the food is transported in the form of;
(a) Glucose (b) Sucrose
(c) Starch (d) Proteins

2. Stomata close when the guard cells;
(a) Lose water
(b) Gain chloride ions
(c) Become turgid
(d) Gain potassium ions

3. Trace the pathway of water from the soil through the plant to the atmosphere.
(a) Endodermis, cortex, epidermis, xylem, intercellular spaces in mesophyll, stomata
(b) Epidermis, endodermis, phloem, cortex of leaf, intercellular spaces of mesophyll, stomata
(c) Root hairs, epidermis, Cortex, xylem, endodermis, intercellular spaces in mesophyll, stomata
(d) Root hairs, cortex, endodermis, xylem, intercellular spaces in mesophyll, stomata

4. When fibrinogen makes blood clot, it separates from blood and the remainder is called;
(a) Plasma (b) Lymph
(c) Serum (d) Puss

5. What is correct about human red blood cells?
(a) Have limited life span
(b) Are capable of phagocytosis
(c) Produce antibodies
(d) Are multinucleate

6. Which of the following tissue layer is found in all blood vessels?
(a) Smooth muscle
(b) Endothelium
(c) Skeletal muscle
(d) Connective tissue

7. When do the atria contract?
(a) Before diastole
(b) after systole
(c) During diastole
(d) during systole

8. Which of following contains deoxygenated blood in an adult human?
(a) Left atrium
(b) pulmonary artery
(c) Pulmonary vein
(d) All of the above

9. Which of the following chambers has the thickest walls in human heart?
(a) Right atrium (b) Left atrium

(c) Left ventricle (d) Right ventricle

10. Which of these statements is correct about the circulatory system?

(a) It transports hormones

(b) Capillaries have thicker walls than veins

(c) Systemic circulation carries blood to and from the lungs

(d) All are true

11. The exchange of materials between the blood and the surrounding tissues occurs in;

(a) Arteries (b) Veins

(c) Capillaries (d) All of the above

12. Which of the following is a type of leukocyte?

(a) Lymphocytes (b) Eosinophil

(c) Monocyte (d) All of the above

13. Which of the following is a function of human blood?

(a) It regulates body temperature

(b) It transports wastes

(c) It provides defense

(d) All of the above

14. Valves to prevent the backflow of blood are found in;

(a) Arteries (b) Veins

(c) Capillaries (d) All of the above

15. Plasma is made up of water and ____________.

(a) Metabolites and wastes

(b) Salts and ions

(c) Proteins

(d) All of the above

16. Which of these are responsible for blood clotting?

(a) Platelets (b) Erythrocytes

(c) Neutrophils (d) Basophils

17. Find the correct path of blood circulation.

(a) Left atrium, left ventricle, lungs, right atrium, right ventricle, body

(b) Right atrium, right ventricle, lungs, left atrium, left ventricle, body

(c) Left atrium, left ventricle, right atrium, right ventricle, lungs, body

(d) Right atrium, lungs, right ventricle, left atrium, body, left ventricle

18. A patient with blood group A can be given the blood of donor who has;

(a) Blood group A or AB

(b) Blood group A or O

(c) Blood group A only

(d) Blood group O only

19. The death of the heart tissue is called;

(a) Arteriosclerosis

(b) Atherosclerosis

(c) Myocardial infarction

(d) Thalassaemia

20. What happens when a mismatched blood group is injected in recipient?

(a) Antibodies of the recipient's blood destroy donor's RBCs

(b) Antibodies of the donor's blood breakdown recipient's RBCs

(c) Both of these can happen

(d) None of these happens and such transfusion can be safe

21. Which of the followings in not true about the opening and Closing of Stomata?

(a) Light helps in the opening and closing of stomata

(b) K^+ ions are responsible for the opening and closing of stomata

(c) The osmosis of water is responsible for the opening and closing of stomata

(d) None of these

22. The rate of transpiration is increased when:

(a) Low light

(b) Temperature decrease

(c) Humidity increased

(d) none of these

23. Which of the followings is area of supply of food in plants?

(a) Leaf (b) Stem

(c) Fruit (d) All

24. There is separation of oxygenated and deoxygenated blood in birds and mammals because:

(a) The ventricles are completely divided

(b) The ventral aorta is divided into aortic and pulmonary trunk.

(c) The aortic arch is divided into two systemic arches.

(d) None of above

25. Which of the following blood vessels have oxygenated blood?

(a) Pulmonary artery

(b) pulmonary vein

(c) Superior vena cave

(d) inferior vena cave

26. The amount of plasma in blood is:

(a) 35% (b) 45%

(c) 55% (d) 65%

27. The percentage of inorganic salts and ions in the plasma is.:

(a) 0.6 (b) 0.7

(c) 0.8 (d) 0.9

28. The normal pH of the human blood is:

(a) 6.4 (b) 7.4

(c) 8.4 (d) 9.4

29. The percentage of the plasma protein in the blood is:

(a) 4 – 5 (b) 5 – 6

(c) 7 – 8 (d) 7 – 9

30. Which of the following proteins is not present in the plasma of the blood?

(a) Immunoglobulin or antibodies

(b) Prothrombin

(c) Haemoglobin

(c) Fibrinogen

31. Which of the following cells is most abundant in the blood?

(a) Red blood cells

(b) White blood cells

(c) Platelets

(d) None of the above

32. A cubic millimeter blood of male contains RBC:

(a) 5 – 5 .5 million

(b) 4 – 4.5 million

(c) 3 – 4 million

(d) none of the above

33. Which of the followings are not Granulocytes?

(a) Neutrophils (b) eosinophils

(c) Monocytes (d) basophils

34. Pus is formed from which of the following dead white blood cells?

(a) Lymphocytes (b) eosinophils

(c) Monocytes (d) basophils

35. Which of the following structure are not cells.

(a) Lymphocytes (b) eosinophils

(c) Monocytes (d) platelets

36. Which of the following process is a homeostasis?

(a) To maintain the amount of water constant in the blood

(b) To maintain the functioning of the body

(c) To maintain the process of respiration

(d) To maintain the muscular activity

37. Which of the following is not the function of blood?

(a) It transport gases in the body

(b) It transports reproductive cells in the body

(c) It transport food within the body

(d) It transport waste material in body

38. Which of the followings is Leukaemia?

(a) Uncontrolled production of RBC

(b) Uncontrolled production of WBC

(c) Uncontrolled production of Platelets

(d) All of the above

39. Thalassaemia is an abnormality of:

(a) RBC (b) WBC

(c) Platelets (d) None of these

40. The valve present between right atrium and right ventricle is called:

(a) Tricuspid valve

(b) Bicuspid valve

(c) Semilunar valve

(d) none of the above

41. The valve present between left atrium and left ventricle is called:

(a) Tricuspid valve

(b) Bicuspid valve

(c) Semilunar valve

(d) none of the above

42. The valve present at the base of aorta is called:

(a) Tricuspid valve

(b) Bicuspid valve

(c) Semilunar valve

(d) none of the above

43. Which of the following arteries supply blood to legs?

(a) Femoral artery

(b) Renal artery

(c) Coronary artery

(d) pulmonary artery

44. Which of the following veins does collect blood from the digestive system and supply blood to liver?

(a) Hepatic vein

(b) Hepatic portal vein

(c) Renal veins

(d) none of the above

45. The voice of lubb is produced during the contraction of heart when:

(a) Tricuspid valve is closed

(b) Bicuspid valve is closed

(c) Both tricuspid and bicuspid valves are closed

(d) Semilunar valves are closed

46. The voice of dub is produced during the contraction of heart when:

(a) Tricuspid valve is closed

(b) Bicuspid valve is closed

(c) Both tricuspid and bicuspid are closed

(d) Semilunar valves are closed

47. Which of these layers is present in the arteries?

(a) Connective tissues and elastic fibres

(b) Smooth and circular muscles

(c) Connective tissues

(d) All of the above

48. Which of the followings is Atherosclerosis?

(a) The breaking of the wall of the artery

(b) The narrowness of the wall of the artery

(c) The deposition of fats in the wall of the artery

(d) None of the above

49. Which of the followings is the characteristic of capillary?

(a) It has three layers of endothelium

(b) It has one layer of endothelium

(c) It has one layer of connective tissues

(d) It has one layer of elastic tissues

50. Which of followings is the main function of capillaries?

(a) Supply blood to tissues

(b) Exchange of materials

(c) Bring blood from tissues

(d) Transport of materials

51. Which of the following layers is thin in veins?

(a) Connective tissues and elastic fibres

(b) Smooth and elastic tissues.

(c) Connective tissues

(d) All of the above

52. Which of following veins has oxygenated blood?

(a) Renal vein

(b) Hepatic vein

(c) Pulmonary vein

(d) Coronary vein

53. In which of the following blood vessels has high blood pressure?

(a) Artery (b) Vein

(c) Capillary (d) non of the above

54. In which of the following blood vessels, pulse is felt?

(a) Artery (b) Vein

(c) Capillary (d) non of the above

55. Which of the followings are blood vessels responsible for exchange of material?

(a) Artery (b) Vein

(c) Capillary (d) none of the above

56. Which of followings is the cause of hypertension?

(a) Low blood pressure

(b) High blood pressure

(c) Cholesterol level

(d) All of the above

57. Which of the followings is thrombus?

(a) A blockage of blood vessel

(b) A clot in the vessel

(c) A moving clot in vessel

(d) None of the above

58. Which of the following is embolus?

(a) A blockage of blood vessel

(b) A clot in the vessel

(c) A moving clot in vessel

(d) None of the above

59. Which of the following condition is helpful in the prevention of heart attack?

(a) Avoid too much fatty food rich in cholesterol.

(b) Maintain normal body weight

(c) Control the blood pressure by regular walk and exercises.

(d) All of the above

60. Tricuspid valve contains no. of flaps:

(a) Four (b) Five

(c) Three (d) Two

(Lahore board 2011 G II)

Answers

1.	**b**	12.	**d**	23.	**d**	34.	**a**	45.	**c**	56.	**b**
2.	**a**	13.	**d**	24.	**a**	35.	**d**	46.	**d**	57.	**b**
3.	**d**	14.	**b**	25.	**b**	36.	**a**	47.	**d**	58.	**c**
4.	**c**	15.	**d**	26.	**c**	37.	**b**	48.	**b**	59.	**d**
5.	**a**	16.	**a**	27.	**d**	38.	**b**	49.	**b**	60.	**c**
6.	**b**	17.	**b**	28.	**b**	39.	**a**	50.	**b**		
7.	**d**	18.	**b**	29.	**d**	40.	**a**	51.	**b**		
8.	**b**	19.	**c**	30.	**c**	41.	**b**	52.	**c**		
9.	**c**	20.	**c**	31.	**a**	42.	**c**	53.	**a**		
10.	**a**	21.	**d**	32.	**a**	43.	**a**	54.	**a**		
11.	**c**	22.	**d**	33.	**c**	44.	**b**	55.	**c**		

Short Questions

Q.1. What is ABO blood group system? Who did discover it?

Ans. It is the most important blood group system in humans, it was discovered by the Austrian scientist Karl Landsteiner in 1900. He found four different blood groups (blood types). He was awarded the Nobel Prize in Medicine for his work. There are four different blood groups in this system. These groups are distinct from each other on the basis of specific antigens (antigen A and B). These antigens are present on the surface of RBC's. After birth, two types of antibodies i.e. anti-A and anti-B antibodies appear in the blood of individuals. These antibodies are present according to the absence of corresponding antigen.

Q.2. What is agglutination?

Ans. Clumping of blood cells during blood transfusion is called agglutination. If agglutination occurs, the clumped cells cannot pass through capillaries.

Q.3. What are agranulocytes?

Ans. These are types of white blood cells. They have clear cytoplasm and include monocytes (produce macrophages which engulf germs) and B and T lymphocytes (produce antibodies and kill germs).

Q.4. What is albumin?

Ans. It is an important protein present in blood which maintains the water balance of blood.

Q.5. What is Angina Pectoris? (Lahore board 2011 G II)

Ans. Angina Pectoris means "Chest Pain". It is not as severe as heart attack. The pain may occur in heart and often in left arm and shoulder. It is a warning sign that blood supply to heart muscles is not sufficient but shortage is not enough to cause death.

Q.6. What are Anti-A antibodies and Anti-B antibodies?

Ans. Antibodies are proteinacious substances produced by lymphocytes. It is a type of white blood cells. These are produced in response to antigens and then pass to plasma and lymph. They are a part of body's immune system.

After birth, two types of antibodies i.e., anti-A and anti-B antibodies appear in the blood serum of individuals. These antibodies are present according to the absence of corresponding antigen.

In persons with blood group A, antigen A is present and their blood contains anti-B antibodies.

In persons with blood group B, antigen B is present. So their blood will contain anti-A antibody.

Q.7. What are antigens? Write about antigen A & B?

Ans. An antigen is a proteinacious molecule that can stimulate an immune response. There are two types of antigens.

Antigen A: A person having antigen A has blood group A.

Antigen B: A person having antigen B has blood group B.

A person having both antigens has blood group AB and person having none of the A and B has blood group O.

Q.8. What is anti-Rh antibody?

Ans. If an Rh-negative person receives Rh-positive blood, he/she will produce anti-Rh antibodies against Rh factors.

Q.9. What are aorta and aortic arch?

Ans. The oxygenated blood leaves the left ventricle of the heart. This blood is pumped into aorta, aorta is largest artery. The aorta ascends and it forms an aortic arch. The arch curves left and descends inferiorly into the body.

Q.10. Define artery. Which blood does it carry?

Ans. The blood vessels carry blood away from the heart are called arteries. All arteries except pulmonary arteries carry oxygenated blood. Their structures are well adapted for their function.

Q.11. What are atherosclerosis and arteriosclerosis?

Ans. The narrowing of the arteries is called atherosclerosis. Hardening of arteries is called arteriosclerosis.

Q.12. Define atrial systole.

Ans. When both atria contract and pump blood towards ventricles, this period in cardiac cycle is called atrial systole.

Q.13. What is an atrium?

Ans. The upper thin-walled chambers of heart are called left and right atria (singular atrium).

Q.14. Define Basophils.

Ans. One of the WBCs is granulocytes. Basophils is a granulocytes which help in preventing blood from clotting.

Q.15. What are tricuspid and bicuspid valves?

Ans. There is opening between the right atrium and the right ventricle. It is guarded by a valve called tricuspid valve. It has three flaps. An opening is also present between the left atrium and the left ventricle. It is guarded by a valve called bicuspid valve. The walls of left ventricle are the thickest. These are about a half – inch thick. They have enough force to push blood into the body.

Q.16. Define blood group systems. **(Lahore board 2011 G I)**

Ans. Blood group system is the classification of blood on the basis of presence or absence of antigens on the surface of red blood cells. An antigen is a molecule that can stimulate an immune response for antibody production. These antigens may be proteins or polysaccharides. Their nature depends on the blood group system.

Q.17. Define capillary. Give its functions?

Ans. The blood vessels composed of single layer of cells which are used for exchange of materials are called capillaries. Capillaries are the smallest blood vessels. These are formed by the divisions of arterioles. The exchange of materials between blood and tissue fluid is carried out through the capillaries.

Q.18. Define cardiac cycle and heart beat?

Ans. The alternating relaxations and contractions make up the cardiac cycle. One complete cardiac cycle makes one heartbeat. Heart relaxes and its chambers fill with blood. It contracts and its chambers propels the blood out of them.

Q.19. What is cardiovascular system?

Ans. Human blood circulatory system is also called cardiovascular system. Like other vertebrates, humans have a closed circulatory system (meaning that blood never leaves the network of arteries, veins and capillaries).

The main components of the human blood circulatory system are blood, heart and blood vessels.

Q.20. Define cohesion tension theory. **(Lahore board 2012 G I)**

Ans. According to this theory, the mechanism by which water (along with dissolved materials) is carried upward through the xylem is called transpirational pull. Transpiration creates a pressure difference. It pulls water and salts up from the roots.

Q.21. What is coronary circulation?

Ans. From the base of aorta, coronary arteries originates and supply blood to heart muscles. Coronary vein collect blood from heart muscles. This circulation is called coronary circulation.

Q.22. What is Cortex?

Ans. External to endodermis in the root and stem, there is a broad zone of cortex. It consists of large and thin - walled cells.

Q.23. Define Diastole.

Ans. When atria and ventricles of heart relax and blood is filled in atria. This period is called cardiac diastole.

Q.24. What is Dorsal aorta?

Ans. As aorta passes down through thorax, it becomes dorsal aorta. It gives off many branches which supply oxygenated blood to different body parts.

Q.25. Define Endodermis and Pericycle.

Ans. In the root and stem, outside the conducting tissues, there is a narrow layer of thin walled cells, the pericycle. A single layer of cells i.e. endodermis surrounds this pericycle.

Q.26. What are thrombus and embolus?

Ans. Thrombus:

Multiple deposits in arteries called plaque. Plaques can form blood clots called thrombus.

Embolus:

If a thrombus dislodges and becomes free floating, it is Called embolus.

Q.27. What is the structure of red blood cells (RBCs) or Erythrocytes?

Ans. These are most numerous blood cells. These cells have nucleus when formed. In the RBCs of mammals, the nucleus, mitochondria, endoplasmic reticulum etc., are lost. These are lost when they mature before they enter blood. About 95% of the cytoplasm of red blood cells is filled with haemoglobin. It transports O_2, and small amounts of CO_2. The remaining 5% consists of enzymes, salts and other proteins. These cells once mature, do not divide.

Q.28. What is Fibrin?

Ans. Fibrin or cholesterol is fatty material when accumulated in the arteries caused narrowing of arteries or artherosclerosis.

Q.29. Which proteins do present in plasma? What is their role?

Ans. Proteins constitute 7-9 % by weight of the plasma. The proteins which are present in plasma:

(i) **Antibodies:** Antibodies are produced by lymphocytes. It is a type of white blood cells. These are produced in response to antigens and then passed to plasma and lymph. They are a part of body's immune system.

(ii) **Fibrinogen:** Fibrinogen is a plasma protein. It takes part in the blood clotting process.

Q.30. What are granulocytes?

Ans. Granulocyte is a type of WBCs and have glanular cytoplasm. These include:

(v) Neutrophils (destroy small particles by phagocytosis)

(vi) Eosinophils: (break inflammatory substances and kill parasites)

(vii) Basophils, prevent blood clotting

Q.31. What are guard cells? **(Lahore board 2012 G I)**

Ans. Guard cells are bean shaped cells in the lower epidermis of the leaf which control the opening and closing of stomata.

Q.32. What is Haemoglobin?

Ans. About 95% of the cytoplasm of RBCs is filled with a protein called haemoglobin which transports O_2 and small amounts of CO_2. It is red in colour and red colour of blood is due to haemoglobin.

Q.33. What are heart rate and pulse rate?

Ans. The number of times the heart beats per minute is called **heart rate.** At rest, heart rate is 60 – 90 times, 70 is average. The heart rate can be measured by feeling the pulse. Pulse is the rhythmic expansion and contraction of an artery as blood is forced through it by the regular contractions of the heart. The pulse can be felt at the areas where the arteries are close to the skin. Its examples are wrist, neck, groin or top of the foot.

Q.34. What are lenticels?

Ans. Lenticels are special openings in the stems of some plants. It helps in transpiration.

Q.35. Define Leucocytes or white blood cells?

Ans. These are colourless. They are granular or agranular, contain large nucleus larger in size than RBCs. Their average number is 7500/mm^3 Of blood. They play role in body's defence by engulfing small particles, release anticoagulants or produce antibodies.

Q.36. What is leukaemia (blood cancer)? **(Lahore board 2011 G I)**

Ans. The uncontrolled production of cells is called cancer. In leukaemia, a great number of immature and abnormal white blood cells appear in the bone marrow. They are also often produced in the spleen and liver. This is caused by a cancerous mutation in bone marrow cells. It results in production of uncontrolled white blood cells. The mutated bone marrow cells spread to other parts of the body. So white blood cells start producing in many other organs. These white blood cells are not completely differentiated. Therefore, they are defective.

Q.37. What are lymphocytes?

Ans. Lymphocytes are agranulocytes. Two types are B and T lymphocytes which produce antibodies and kill germs.

Q.38. Define Megakaryocytes.

Ans. Platelets are not cells, but are fragments of large cells of bone marrow called megakaryocytes. They do not have any nucleus and any pigment and help in blood clotting.

Q.39. Define Monocytes.

Ans. Monocytes are agranulocytes which produce macrophages which engulf germs.

Q.40. Define neutrophils.

Ans. Neutrophils are granulocytes which destroy small particles by phagocytosis.

Q.41. What is myocardial infarction?

Ans. The term myocardial infarction is derived from myocardium (the heart muscle) and infarction (tissue death). It is more commonly known as a heart attack. It occurs because of

(1) Interruption in the blood supply to the heart muscles.

(2) Blood clot in coronary arteries.

Q.42. What is pericardium?

Ans. The heart is enclosed in a sac called pericardium. A pericardial fluid is present between the pericardium and the heart walls. It reduces friction between the pericardium and heart during contractions.

Q.43. What are Xylem and Phloem?

Ans. Xylem: Xylem tissue is responsible for the transport of water and dissolved substances from roots to aerial parts. It consists of vessel elements and tracheids.

Phloem: Phloem tissue is responsible for the conduction of dissolved organic matter (food) between different parts of plant body. It consists of sieve tube cells and companion cells.

Q.44. What do you know about platelets or thrombocytes?

Ans. They are not cells but are fragments of large cells of bone marrow. Platelets help in conversion of fibrinogen into fibrin. Fibrinogen is a soluble plasma protein. The fibrin threads entangle with the red blood cells and other platelets in the area of damaged tissue. They ultimately form a blood clot.

Q.45. What is plasma?

Ans. Plasma is primarily water in which proteins, salts, ions, metabolites and wastes are dissolved. Water constitutes about 90-92% of plasma. 8-10% of plasma are dissolved substances.

Q.46. What are pulmonary arteries?

Ans. The large pulmonary trunk emerges from the right ventricle. It divides into right and left pulmonary arteries. These arteries carry the deoxygenated blood to the right and the left lungs.

Q.47. What is pulmonary pathway or circuit?

Ans. This pathway carries deoxygenated blood from the heart to the lungs. It brings oxygenated blood from lungs to the left atrium of heart. It has lower pressure than systemic circulation. It gives sufficient time for gaseous exchange to occur in the lungs:

Q.48. Define Pulmonary Veins.

Ans. Veins from lungs bring the oxygenated blood to the left atrium of heart are called pulmonary veins.

Q.49. What is Pulse?

Ans. Pulse is the rhythmic expansion and contraction of an artery as blood is forced through it by the regular contractions of heart.

Q.50. What is Rh Blood group system? Who did discover it?

Ans. Karl Landsteiner in 1930's discovered the Rh-blood group system. In this system, there are two blood groups i.e. Rh^+ and Rh^-. They are distinct from each other on the basis of antigens called Rh factor. Rh factor was first discovered in Rhesus monkey. It is present on the surface of RBCs. A person having Rh factor has blood group Rh-positive while a person not having Rh factor has blood group Rh-negative.

Q.51. What is the importance of root hairs?

Ans. Root hairs provide large surface area for absorption. They grow out into the spaces between soil particles where they are in direct contact with the water. The cytoplasm of the root hairs has higher concentration of salt than the soil water. Therefore, water moves by osmosis into the root hairs. Salts also enter root hairs by diffusion or active transport.

Q.52. What are semilunar valve?

Ans. There are two types of semilunar valves:

(a) Pulmonary Semilunar Valve

At the base of pulmonary trunk, pulmonary semilunar valve is present which prevents the back flow of blood from pulmonary trunk to right ventricle.

(b) Aortic Semilunar Valve

At the base of aorta, aortic semilunar valve is present which prevents the back flow of blood from aorta to left ventricle.

Q.53. What is stoma? **(Lahore board 2011 G I)**

Ans. Stomata (singular: stoma) are minute openings in the lower epidermis of leaves guarded by guard cells. Stomata helps in exchange of gases.

Q.54. What is systematic circulation?

Ans. The pathway on which oxygenated blood is carried from heart to body tissues and in return deoxygenated blood is carried from body tissues to heart is called systemic circulation.

Q.55. Define transpiration. How does it take place? **(Lahore board 2012 G II)**

Ans. The loss of water from surface of plant through evaporation is called transpiration. This loss may occur through stomata in leaves. It may occur through the cuticle present on leaf-epidermis. It also occurs through special openings called lenticels. Lenticels are present in the stems of some plants.

Q.56. What is Thalassaemia? Who did discover it?

Ans. It was discovered by Thomas B. Cooley. Therefore, it is also called Cooley's anaemia. It is a genetic problem. It is caused due to mutations in the gene of haemoglobin.

Q.57. What is transpirational pull?

Ans. The pulling force created by the transpiration of water is called transpirational pull. It also causes water to move transversely (from root epidermis to cortex and pericycle).

Q.58. Define veins. What blood do they carry?

Ans. A blood vessel that carries blood toward the heart is called vein. All veins except pulmonary veins, carry deoxygenated blood. Veins are also well-adapted to their function. The walls of vein, are composed of the same three layers like artery wall.

Q.59. What are superior and inferior vena cava?

Ans. Superior vena cava: Different veins from the head, shoulders and arms join together to form superior vena cava.

Inferior vena cava: Different veins from posterior part of body join to form inferior vena cava.

Q.60. Define ventricles.

Ans. The lower thick walled chambers of the human heart are called left and right ventricles. Left ventricle is the largest and strongest chamber in heart.

Q.61. What is atrial and ventricular systole?

Ans. When both atria contract and pump the blood towards ventricles, this period in cardiac cycle is called atrial systole. Atrial systole takes 0.1 seconds. Now both ventricles contract. They pump the blood towards body and lungs. The period of ventricular contraction is called ventricular systole. Ventricular systole lasts about 0.3 seconds.

Q.62. Define venule.

Ans. In tissues, capillaries join to form small venules, which join to form veins.

Q.63. What do you know about wilting?

Ans. Transpiration maybe a harmful process in the sense that during the conditions of drought, loss of water from plant results in serious desiccation, wilting and often death.

Q.64. What is importance of water for plants?

Ans. Water is vital to plant life. It is necessary for photosynthesis and turgor. Much of the cellular activities occur in the presence of water. Water also regulates internal temperature of the plant.

Q.65. What are the functions of Root?

Ans. Roots perform vital functions

1. Roots anchor the plant in the soil..
2. They absorb water and salts from the soil.
3. They provide conducting tissues. These tissues distribute these substances to the tissues of the stem.

Q.66. How do stomata open and close?

Ans. The guard cells of stomata absorb water and become turgid, their margins Curve apart. The stoma between them opens. When guard cells lose water, they become flaccid and stomata are closed.

Q.67. What is the role of K^+ in opening of stomata?

Ans. The blue wave lengths of day light allows K+ to flow into guard cells from the surrounding epidermal cells. Water passively follows these ions into guard cells. It increases their turgidity and open stoma.

Q.68. How temperature effects transpiration?

Ans. High temperature increases the kinetic energy of water molecules. In this way it increases the rate of transpiration. The rate of transpiration doubles with every rise of 10°C in temperature. But very high temperature 40-45°C causes closure of stomata

Q.69. What is the effect of humidity on transpiration?

Ans. Water vapours diffuse quickly in dry air. Water evaporates from the surface of mesophyll cells into leaf air spaces. They then move from air spaces to outside. This increases the rate of transpiration. In humid air, the rate of the diffusion of water vapours is

reduced. As the air is already saturated with water vapours, thus the rate of transpiration is low.

Q.70. What is the harmful effects of transpiration?

Ans. Transpiration requires wet surfaces from which evaporation can occur. But water is lost from the plant during the drought conditions. It results in wilting, serious desiccation. It often causes death of the plant in such conditions. This is the reason plant closes stomata at high temperatures. It reduces transpiration rate to prevent wilting.

Q.71. Differentiate source from sink.

Ans. The source is exporting organs It may be a mature leaf or storage organ. Sinks are the areas of active metabolism or storage. For example, roots, tubers, developing fruits and leaves, and the growing regions.

Q.72. Define blood. **(Lahore board 2011 G I)**

Ans. Blood is a specialized form of connective tissue that is composed of a liquid called blood plasma and blood cells suspended within the plasma. The weight of blood in our body is about $\frac{1}{12th}$ of our body. The average adult has a blood volume of 5 litres.

Q.73. Which salts do present in plasma?

Ans. The salts make up 0.9% of the plasma by weight. More than two third of this amount is sodium chloride (the table salt). Salts of bicarbonate are also present in considerable amounts. Ca, Mg, Cu, K and Zn are found in trace amounts.

Q.74. Which nitrogenous wastes do present in plasma?

Ans. Plasma also contains nitrogenous waste products. These wastes are formed as a result of cellular metabolism. These are urea and salts of uric acid.

Q.75. Where are RBC formed and destroyed?

Ans. They are formed in liver and spleen in the embryonic and foetal life. In adults, they are formed in the red bone marrow of short and flat bone. The average life span of a red blood cell is four months (120 days). After this, they break down in liver and spleen by phagocytosis.

Q.76. Write three functions of blood.

Ans. Blood is the major agent for the transport of materials in the body, transports nutrients, water, salts and waste products. It also transports hormones from the endocrine tissues to the target sites. Blood transports respiratory gases O_2 and CO_2. Blood helps in body's defense against diseases.

Q.77. What is role of blood in homeostasis?

Ans. Blood maintains body temperature and concentration of water and salts. Blood is also responsible for maintaining the amounts of chemicals in the body constant or nearly constant levels. It thus helps in homeostasis.

Q.78. What is the treatment of Thalassaemia?

Ans. The blood of these patients is replaced regularly with normal blood. It can also be cured by bone marrow transplant. But it is very expensive and does not give 100% cure rate. The world celebrates the international Thalassaemia Day on 8^{th} of May.

Q.79. What are blood group AB and O?

Ans. A person having both antigens A and B has blood group AB. Both antigens are present in it. So their blood serum will contain no antibody. A person having none of the A and B antigens has blood group O. So their blood serum will contain both anti A and anti B antibodies.

Q.80. What is the process of cross matching?

Ans. During blood transfusion process, in order to avoid agglutination, blood sample of donor and recipient's blood are cross matched for compatibility. Antibodies of the recipient's blood may destroy the corresponding antigen containing RBCs of the donor. Similarly, the antibodies of the donor's blood may destroy the antigen containing RBCs of the recipient.

Q.81. What are universal donors and universal recipients?

Ans. Individuals with blood group O are called **universal donors**. They can donate blood to the recipients of every other blood group. Individuals with blood group AB are called **universal recipients**. They can receive transfusions from the donors of every other blood group.

Q.82. What is human heart?

Ans. The heart is a muscular organ. It contracts repeatedly. It is responsible for pumping blood through the blood vessels. Cardiac means related to the heart. The bulk of the walls of the heart chambers is made of cardiac branched striated cells. Each cell has single nucleus. These are capable of strong contraction and relaxation making the heart " a pumping organ."

Q.83. How heart works as double pump?

Ans. Human heart works as a double pump. It receives deoxygenated (with less oxygen) blood from body. It then pumps it to the lungs. At the same time, it receives oxygenated (with more oxygen) blood from lungs. It pumps it to all the body. The deoxygenated and oxygenated bloods are separated inside heart chambers.

Q.84. How is sound produced during heartbeat?

Ans. The ventricles contract the tricuspid and bicuspid valves close. It produces sound of lubb. Now ventricles relax and the semilunar valves close. It produces sound dubb. Lubb – dubb can be heard with the help of a stethoscope.

Q.85. What layers are present in the artery?

Ans. The outermost layer of artery is composed of connective tissue. The middle layer is made up of smooth muscles and elastic tissue. The innermost layer is made up of mainly endothelial cells. The hollow internal cavity in which the blood flows is called the lumen.

Q.86. Which scientists did play role in the discovery of blood circulation in blood vessels?

Ans. Two important scientists gave the knowledge of the blood circulatory system. These were:

(i) Ibn-e-Nafees (1210-1286): He was a physician. He was the first scientists who described the pathway of blood circulation.

(ii) William Harvey (1578-1651): He discovered the pumping action of heart. He also described the pathway of blood in major arteries and veins.

Q.87. What is hepatic portal system?

Ans. Many veins come from stomach, spleen, pancreas and intestine opens into hepatic portal vein. It carries the blood to the liver. Hepatic vein carry blood from liver. It opens into inferior vena cava.